

## SIGNATURES

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**RECORD OF REVISIONS**

<b><u>Rev. No.</u></b>	<b><u>Date</u></b>	<b><u>Description</u></b>	<b><u>POC</u></b>	<b><u>OIC</u></b>
0	06/29/99	Document rewritten and reformatted to support LIR 220-03-01. This chapter supersedes LANL Engineering Standards Drafting Manual, Vol. 2, Rev. 7, dated 4/17/98.	Danny Nguyen, <i>PM-2</i>	Dennis McLain, <i>FWO-FE</i>
1	10/29/01	Major Revision. <ul style="list-style-type: none"><li>• Section 100: Acronym list deleted and National Standards referenced; definition section added; symbol legends created &amp; numbered; drawing revision procedures expanded.</li><li>• Sections 201-209: Drawing size &amp; format defined; added grid reference; title blocks modified for new numbering system; title sheets required, fonts, line widths, text height, line types explained; location plan pinpointed; north symbol generated &amp; location defined; partial &amp; key plans defined; graphic scales defined; drawing scales expanded.</li><li>• Sections 210-216: Discipline ID &amp; sheet numbering changed to NCS; text standardized; electronic file naming convention expanded &amp; defined.</li><li>• Section 300: Symbols - generated &amp; on-line; Civil – expanded; Structural – slight modification; Architectural, Mechanical, Electrical - expanded greatly; Mechanical and Electrical - also refer to LEM new examples.</li></ul>	Richard Trout, <i>FWO-SEM</i>	Mitch S. Harris, <i>FWO-SEM</i>

**REFERENCES**

ACI 315	Details and Detailing of Concrete Reinforcement, American Concrete Institute
ACI 315R	Manual of Engineering and Placing Drawings for Reinforced Concrete Structures
AIA	Architectural Graphic Standards
AIA	CAD Layer Guidelines
AISC M013	Detailing for Steel Construction
ANSI Y14.5M	Dimensioning and Tolerancing
ANSI Y14.38	Abbreviations and Acronyms
ANSI Y14.100M	Engineering Drawing Practices
ESA	Engineering Science and Applications Division (ESA) Division/Drafting Standards and Guidelines ( <a href="http://www.esa-de.esa.lanl.gov/html/designstandards2.html">www.esa-de.esa.lanl.gov/html/designstandards2.html</a> )
ISA 5.1	Instrument Symbols and Identification (formerly S5.1)
ISA 5.2	Binary Logic Diagrams for Process Operations (formerly S5.2)
ISA 5.3	Graphic Symbols for Distributed Control/Shared Display Instrumentation, Logic & Computer Systems (formerly S5.3)
ISA 5.4	Instrument Loop Diagrams (formerly S5.4)
ISA 5.5	Graphic Symbols for Process Displays
LEM	LANL Engineering Manual
NCS	National CAD Standard ( <a href="http://nationalcadstandard.org">national cad standard.org</a> )
NECA 100	Nat'l Electric Contractor's Assoc, Symbols for Electrical Construction Drawings, 1999
NFPA 170	National Fire Protection Association Standard for Fire Safety Symbols
UDS	Uniform Drawing System (CSI), part of the National CAD Standard

**RECORDS OF REVISION**

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1	10/29/01	General Revision.	Richard Trout, <i>FWO-SEM</i>	Mitch S. Harris, <i>FWO-SEM</i>

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## RECORDS OF REVISION

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0	06/29/99	Document rewritten and reformatted to support LIR 220-03-01. This chapter supersedes LANL Facility Engineering Standards Drafting Manual, Vol. 2, Rev. 7, dated 4/17/98.	Danny Nguyen, <i>PM-2</i>	Dennis McLain, <i>FWO-FE</i>
1	10/29/01	Acronym list deleted and National Standards referenced; definition section added; symbol legends created & numbered; drawing revision procedures expanded.	Richard Trout, <i>FWO-SEM</i>	Mitch S. Harris, <i>FWO-SEM</i>

## 101 INTRODUCTION

The purpose of the LANL Drafting Manual is to establish a formal system of drafting requirements required by LIR220-03-01, LANL Engineering Manual, for LANL personnel and subcontractors for nuclear and non-nuclear facilities. Use of this manual is required when creating or modifying drawings for LANL facility projects and preparing revisions. Use of this manual is recommended for programmatic work, where appropriate (facility systems are defined by the [LANL Engineering Manual](#), Chapter 1, Section 210). This manual does not address weapons design work covered by ESA Division procedures.

This manual provides minimum requirements for applying drafting concepts to both the initial development of drawings and their subsequent modification. The requirements of this manual apply to new drawings **only** (doesn't force updating of existing drawings). One **exception** is the case of revisions, for which Section 103 applies. The information contained herein is by no means all encompassing; however, this manual does present enough information to provide the user with a fundamental working knowledge level sufficient to understand the concepts presented. The manual web address is:

<http://www.lanl.gov/orgs/f/f6/pubf6stds/drftman/newdrftman.html>

The October 2001 revision of this manual introduced reliance upon the National CAD Standard (NCS) for some requirements. LANL users can access some of this material from the FWO-SEM Homepage (internal; future) [http://arania.lanl.gov:8080/fpub/engineering/index\\_engineering.html](http://arania.lanl.gov:8080/fpub/engineering/index_engineering.html). AE's and others outside the firewall will be required to purchase the NCS from [www.nibs.org](http://www.nibs.org).

**Notes:** 1.) All stated fonts are AutoCAD. 2.) Guidance statements (as apposed to requirements) appear in italics or are clearly understood as such.

### 1.0 ACRONYMS AND ABBREVIATIONS

- A. When abbreviating, comply with ANSI Y14.38, Abbreviations and Acronyms, or the NCS (also referred to as the Uniform Drawing System UDS). Use the same system throughout drawing set.
  - 1. The referenced standard for abbreviations is not intended to be a complete listing of all possible abbreviations required for a project. If additional abbreviations are required, use standard industry abbreviations. An abbreviation legend is required for abbreviations used in the drawing set that are not referenced in the LANL Drafting Manual.
- B. Do not abbreviate single words with four letters or less, except for some very commonly used abbreviations such as:
  - &    and
  - @    at
- C. Avoid using abbreviations with more than one meaning except where they occur in different disciplines or when used in a context that makes the meaning unequivocally clear.

- D. In general, write abbreviations in capital letters with no lower case letters or punctuation (except H<sub>2</sub>O, CO<sub>2</sub>, etc.). Use punctuation only when the abbreviation can be interpreted as a word without the punctuation such as: NO. (number). In this case, a period is needed for clarity.

## **2.0 DEFINITIONS**

### **A. Drawing Sheet Types:**

**Note:** These are used for drawing numbers and set organization (see Section 210).

**Plans:** Views of horizontal planes, showing components in their horizontal relationship.

**Elevations:** Views of vertical planes, showing components in their vertical relationship, viewed perpendicularly from a selected vertical plane.

**Sections:** Views of vertical cuts through and perpendicular to components, showing their detailed arrangement.

**Large Scale Views:** Views of plans, elevations, or sections at a larger scale and with more detail than the referenced view.

**Details:** Plans, elevations, or sections that provide more specific information about a portion of a project component or element than smaller scale drawings.

**Diagrams:** (Schematics) Non-scaled views showing arrangements of special system components and connections not possible to clearly show in scaled views (e.g., one-lines, process flow, piping & instrument, grounding, instrument & control, lightning, wiring, riser, etc).

**Schedules:** Tables or charts that includes data about materials, products, and equipment (e.g., panel schedules, mechanical equipment lists, door and window schedules, submittals).

**3D Representations:** Perspectives, isometric drawings, and electronic CAD models.

### **B. Drawing Formats**

**Note:** P&IDs, fabrication, construction, and architectural drawings can be presented using one of several different formats. The standard formats are cutaway, double-line, one-line, and pictorial. Each format provides specific information about a component or system.

**Cutaway Drawings:** A cutaway drawing is another type of pictorial drawing. In a cutaway, as the name implies, the component or system has a portion cut away to reveal the internal parts of the component or system. This type of drawing is extremely helpful in the maintenance and training areas where the way internal parts are assembled is important. Although not common, these drawings may be ordered by the client upon request. (e.g., 3D representations, diagrams)

**Double Line Drawings:** Double line drawings present the same type of information as a one-line. Double line drawings are useful in layouts and details where space restrictions and retrofits involve tight installations. (e.g., plans, elevations, details)

**Electrical One-Lines:** Designed to present functional information about the electrical design of a system or component. They provide the same types of information about electrical systems that P&IDs provide for piping and instrument systems. Electrical one-lines are not drawn to scale. Examples of typical one-lines are site or building power distribution, and motor control centers. (These are sometimes called single-lines.) (e.g., diagrams) See LEM, Chapter 7, [ST7002](#) Drawing.

**Pictorial Drawings:** Pictorial or double line drawings present the same type information as a one-line, but the equipment is represented as if it had been photographed. It requires much more effort to produce than a one-line drawing and does not present any more information as to how the system functions. (e.g., details, large scale views)

### C. Categories of Drawings

**Note:** These categories are commonly encountered in industry practice and may be referred to throughout this manual. However, drawing sheet numbering is based upon drawing sheet types defined by subpart 2.0A herein.

**Assembly Drawings:** The assembly drawing is a pictorial view of the object with all the components shown as they go together. This type of pictorial is usually found in vendor manuals and is used for part identification and general information relative to the assembly of the component. Although not common for facility work, these drawings may be ordered by the client upon request. (e.g., 3D representations, diagrams)

**Construction (Physical) and Architectural Drawings:** Designed to present the detailed information required to construct or fabricate a part, system, or structure. These three types of drawings differ only in their application as opposed to any real differences in the drawings themselves. (e.g., plans, elevations, sections, details, large scale views, double line drawings)

Construction drawings commonly referred to as “blueprint” drawings, present the detailed information required to assemble a structure on site.

Architectural drawings present information about the conceptual design of the building or structure. Examples are building plans, building elevations (outside view of each side of a structure), equipment installation drawings, foundation drawings, and equipment assembly drawings.

**Electrical Schematics:** Designed to provide interconnection information about an electrical component than the one-lines. Electrical schematic drawings present information such as the individual relays, relay contacts, fuses, motors, lights, and instrument sensors. Examples of typical schematics are valve-actuating circuits, motor starter circuits, and breaker circuits. (e.g., diagrams) See LEM, Chapter 7, [ST7008](#).

**Instrument Loop Diagram:** Is an extension of P&IDs, and illustrate control philosophy and confirm the completeness of submitted data in design, construction, startup, operation, maintenance and modification. For an example, refer to ISA 5.4. These diagrams will be located in the mechanical discipline, 6000 series, Section 211 of this manual.

**Isometric Projection:** The isometric projection presents a single view of the component or system. The view is commonly from above and at an angle of 30 degrees. This provides a more realistic three-dimensional view. This view makes it easier to see how the system looks and how its various portions or parts are related to one another. Isometric projections may or may not be drawn to a scale. (e.g., 3D representations)

**Logic Diagrams:** Logic diagrams can be used to depict several types of information. The most common use is to provide a simplified functional representation of an electrical circuit. It is easier and faster to figure out how a valve circuit works using logic symbols versus using the electrical schematic with its complex relays and contacts. These drawings do not replace schematics, but they are easier to use for certain applications. (e.g., diagrams) For an example refer to ISA S5.2. These diagrams will be located in the electrical discipline, 6000 series, Section 211 of this manual

**Orthographic Projections:** Orthographic projection is widely used for components and assemblies. Orthographic projections present the component or assembly through the use of three views. These are a Top view, a Side view, and a Front view. Other views, such as a bottom view, are used to more fully depict the component or system when necessary. (e.g., 3D representations)

**Piping and Instrumentation Diagrams (P&ID):** Designed to present functional information about a system or component. Piping configuration, flowpaths, pumps, valves, instruments, signal modifiers, and controllers are represented on P&IDs; flow diagrams do not show instrumentation. These drawings are not drawn to a scale and present only the relationship or sequence between components. Common synonyms for P&IDs include EFDs (Engineering Flow Diagrams), UFDs (Utility Flow Diagrams) and MFDs (Mechanical Flow Diagrams, for example, see LANL Engineering Manual, Chapter 6, Drawings [M-6030 and M-6040-6042](#)).

**Priority Drawings:** Priority drawings include the small set of “upper-tier” design drawings that are necessary to support the safe performance of facility operations, maintenance, and design activities within the facility’s approved safety envelope. These drawings typically include piping & instrumentation diagrams, emergency evacuation maps (e.g., floor plans), logic drawings, electrical one-lines, and lightning. (e.g., diagrams, plans, 3D representations). [LIR240-01-01, Configuration Management](#), outlines priority drawing guidelines.

**Process Flow Diagrams (PFD):** Designed to present functional information about a system or component, PFDs depict. Piping configuration, flowpaths, pumps, valves, flow diagrams do not show instrumentation. These drawings are not drawn to a scale and present only the relationship or sequence between components. (e.g., diagrams) See LANL Engineering Manual, Chapter 6, Drawings [M-6010 and M-6020](#) for an example.

#### **D. General Definitions**

**General Note:** Is defined as a word, number, phrase, sentence, or group of sentences that is applicable to, involving, related to, or characteristic to, several, a group, many, or the majority involved. See Section 214 for an example.

**Keyed Note:** Is defined as a word, number, phrase, sentence, or group of sentences that gives specific explanation, identification, or task that provides a solution. See Section 214 for an example.

**Sketch (SK):** Is a rough preliminary, draft, or informal drawing that should follow LANL Drafting Manual Standards, but does not involve Quality Assurance procedures. Sketches are not stand alone documents and are normally associated with Engineering Change Notice, Field Change Notice and Design Change Packages.

**Plate (PL):** Is similar to a sketch that in that it is associated with Engineering Studies, Conceptual Design Reports, Conceptual Design Plans (CDP), Design Criteria (DC).

**Standard Drawing (ST):** Is a LANL produced formal drawing depicting standard details to provide a consistent method of construction and installation of equipment for all disciplines and achieve standardization in a record drawing set. These are on-line in the various LANL Engineering Manual Chapters.

## **102 PLANNING AND COMPOSITION OF DRAWINGS**

### **1.0 GENERAL FORMATTING GUIDELINES**

- A. *Proper planning and presentation of the drawing sheets is very important. Make every effort to anticipate and plan for the drawing space layout now and for future modifications: the symbols required, use of consistent terminology, and coordination of disciplines.*
- B. *Map space in advance for each plan, section, elevation, detail, schedule, etc.*
- C. *Each design group should develop a process for in-house design verification that is a formal documented procedure for ensuring technical reviews for drawing: development, design, change and regulatory compliance. Draft could be controlled by letter revisions, e.g.: Revision A - research and layout; Revision B - walkdowns and design; Revision C - engineering overlay; Revision D - Final Review.*

### **2.0 GENERAL FORMATTING REQUIREMENTS**

- A. Arrange each drawing so that it will not appear unbalanced or crowded.
- B. Use drafting conventions that are clear, uniform and easily understood.
- C. Use drafting conventions that are clear and readable, when the sheet is reduced to half size (e.g., D size to B size).
- D. Use consistent line widths, text height, and line types in a drawing set for clarity and accuracy.
- E. Do not combine different disciplines or systems on the same drawing sheet.
- F. Show or call out information the least number of times possible, preferably once.
- G. Coordinate embodiments, inserts, block-outs, and penetrations with all disciplines to ensure that the drawing set conveys consistent information.
- H. Use terminology in the drawing set that is consistent with the terminology in the related specifications.
- I. Vendor drawings may be part of a document drawing set, but are used only as reference drawings used for fabrication, installation, or As-Built by the vendor. These drawings do not need to conform to the LANL Drafting standards and are to be labeled as "reference drawings" 1/4" text height located to the left of the Title Block.

**3.0 DRAWING LEGEND**

- A. Provide a standard legend of symbols and line treatment on the first drawing sheet of each discipline for the drawing set.
- B. Symbols used in the drawing package that do not appear in the standard LANL symbol library shall be identified on the symbol legend in drawing set, by using the letters “NS” (non-standard) enclosed in parenthesis to the right of the symbol description.
- C. A drawing legend will occur on the first sheet for each discipline identified by the discipline designator, followed by a “ - ” then followed by numerical sequence (e.g., A-0001).

## **103 DRAWING REVISIONS**

### **1.0 DRAWING REVISION**

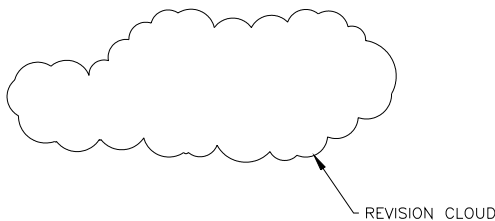
*Guidance: For existing facility modifications, designers should make every effort to locate and revise existing drawings rather than create new drawings addressing required work.*

- A. If a drawing has no revision, enter a “Rev. 0” in the revision block of the title block and issue for sign-off during final submittal.
- B. Indicate revisions by numbers, beginning with the number “1.” Use a sequential number for each revision on a sheet.
- C. Number each revised sheet independently.
- D. Enter the appropriate information in the revision block of the drawing title block.
- E. In the Title Sheet indicate each revised drawing sheet by drawing a revision cloud around the current revision number listed in the “Revision Column;” see Figure 203-1.
- F. Use the AutoCAD “cloud” command for revisions (layer-cloud, color- white, pen weight 0.35 mm, line type-continuous) to completely encircle the revised drawing elements. On subsequent revisions, delete the previous revision clouds. A revision cloud is illustrated in Figure 103-1 item 15.
- G. A revision cloud is not required on a drawing sheet if the whole sheet was revised or it is a new sheet added to the drawing set.
- H. Indicate the current revision number in the “NO.” column of the revision block and “REV.” block of the title block (see Figure 103-1).
- I. Indicate the current revision date in the “DATE” column of the revision block.
- J. Hand written initials or signatures are not required in the title block or on previous revision block entries, but are required in the revision block for the current revision.

- K. The following are graphic examples of the Title Block modifications required and Sample Cloud when revisions have been made on a Drawing sheet.

1	1/1/00	MN	ADDED EXHAUST FAN IN ROOM 101	DM	AT	MN	MN	GL
NO	DATE	CLASS REV	DESCRIPTION	DWN	VER	CHKD	SUB	APP

DRAWING NO	REV
C76391	1



*Figure 103-1*

- L. Non-electronic drawings that are to be revised into electronic format shall be converted using current LEM drafting standards.
- M. Electronic drawings to be revised that have
- Minor changes (effecting less than 30%) shall be modified using the existing drawing format and symbology and current revision procedure;
  - Major changes (effecting more than 50%) shall be completely upgraded to the current standards and depicting the area changed by the revision;
  - Gray area between minor/major (31-49%) upgrade changes to a drawing and/or sets of drawings, shall be determined by the LANL Project Manager;
  - As-Built drawings to be revised shall be upgraded to current LEM drafting standards;
  - Revisions to “Priority Drawings,” electronic or non-electronic, shall be generated to the current LEM drafting standards.

## **2.0 AS-BUILT REVISION**

An As-Built is a special case of a revision. Follow Section 1.0, with the following additional requirements:

- A. Delete all revision clouds from the drawing sheet.
- B. Do not use revision clouds to denote As-Built changes.

- C. Enter the next sequential revision number in the drawing title block. Enter that same number in the revision block.
- D. In the “REVISION” column of the revision block enter “As-Built With Changes,” or “As-Built Without Changes,” whichever is appropriate (Table 202-1, Item 4 “Revision Description” of this manual).
- E. A detailed description of the “As-Built” changes is not required; however, the date of origination is required.
- F. Once the as-built drawing is complete, convert all existing features on the drawing to a 0.35 mm line width and a “continuous” line type. This can be accomplished by using DDLMODES Layer Management. All entities of the drawing (layer, color, line type, etc.) to be by “layer.” Refer to the AutoCAD Users Guide for procedure. This process ends the construction phase of the project and initiates the operation and maintenance phase.

### **3.0 NEWDATE STAMP (GUIDANCE)**

- A. *Newdate is a “lisp” routine to label a drawing as to its location on the server, the date it was created or upgraded, the time it was created or upgraded, and by whom the file was created or upgraded. There are two (2) files named Titleblock Date Stamp (NEWDATE) and NEWDATE.lsp that need to be downloaded to the computer in the AutoCAD2000/Support folder. These files can be found in the LANL Drafting Manual\Appendices: Drafting Symbols under Titleblocks at: [http://www.lanl.gov/orgs/f/f6/pubf6stds/drftman/drft\\_symbols.html](http://www.lanl.gov/orgs/f/f6/pubf6stds/drftman/drft_symbols.html) In AutoCAD, under the pull-down menu “TOOLS\LOAD APPLICATIONS,” load the NEWDATE.lsp file.*

*On starting a new drawing, after opening, inserting, or xrefing a Title Block, insert the drawing file named “NEWDATE” just outside of the titleblock border on the lower left corner. Type “NEWDATE” and the date stamp should update itself. (See example in Section 203.2, Figure 203-1.)*

- B. *This stamp should appear on all drawings.*

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**RECORDS OF REVISION**

<b><u>Rev.</u></b>	<b><u>Date</u></b>	<b><u>Description</u></b>	<b><u>POC</u></b>	<b><u>OIC</u></b>
0	06/29/99	Document rewritten and reformatted to support LIR 220-03-01. This chapter supersedes LANL Engineering Standards Drafting Manual, Vol. 2, Rev. 7, dated 4/17/98.	Danny Nguyen, <i>PM-2</i>	Dennis McLain, <i>FWO-FE</i>
1	10/29/01	Drawing size & format defined; added grid reference; title blocks modified for new numbering system; title sheets required, fonts, line widths, text height, line types explained; location plan pinpointed; north symbol generated & location defined; partial & key plans defined; graphic scales defined; drawing scales expanded.	Richard Trout, <i>FWO-SEM</i>	Mitch S. Harris, <i>FWO-SEM</i>

## 201 DRAWINGS

### 1.0 DRAWING SHEET SIZES AND FORMAT

- A. Produce standard construction drawings and individually controlled drawings on a "D" size sheet.
- B. Produce Engineering Studies, Conceptual Design Reports, and Design Criteria drawings on a "B" size sheet whenever possible.
- C. Use a consistent size of drawing sheet throughout the Drawing Set.
- D. Provide a continuous line sheet border, as illustrated below, that is 0.75 mm thick (1/16 inch).
- E. Standard drawing sheet sizes, borders, and formats are shown below. The overall dimensions are the sheet cut size.
- F. *Guidance: An "A" size sheet may be used for sketches for Engineering Change Notices (ECN), etc. The title block should contain the same information as in Section 202, Figure 202-4.*

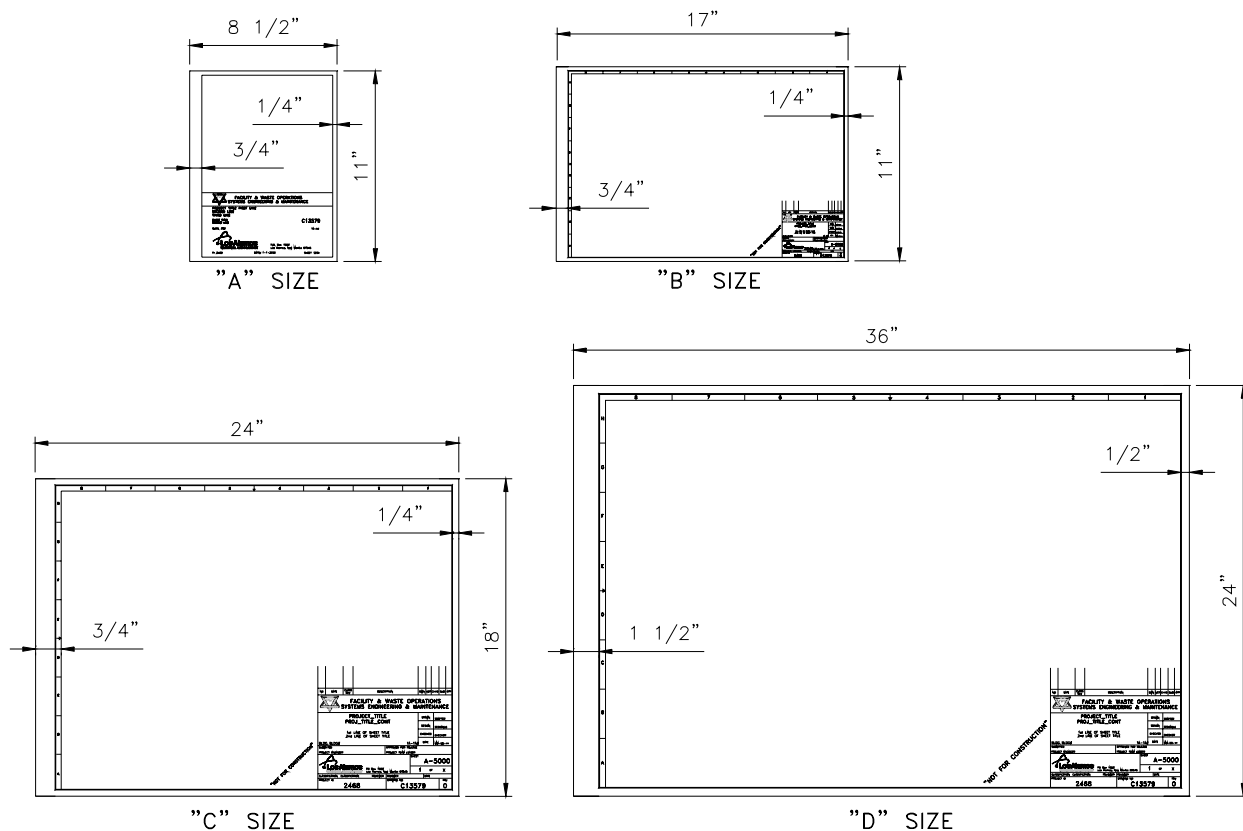
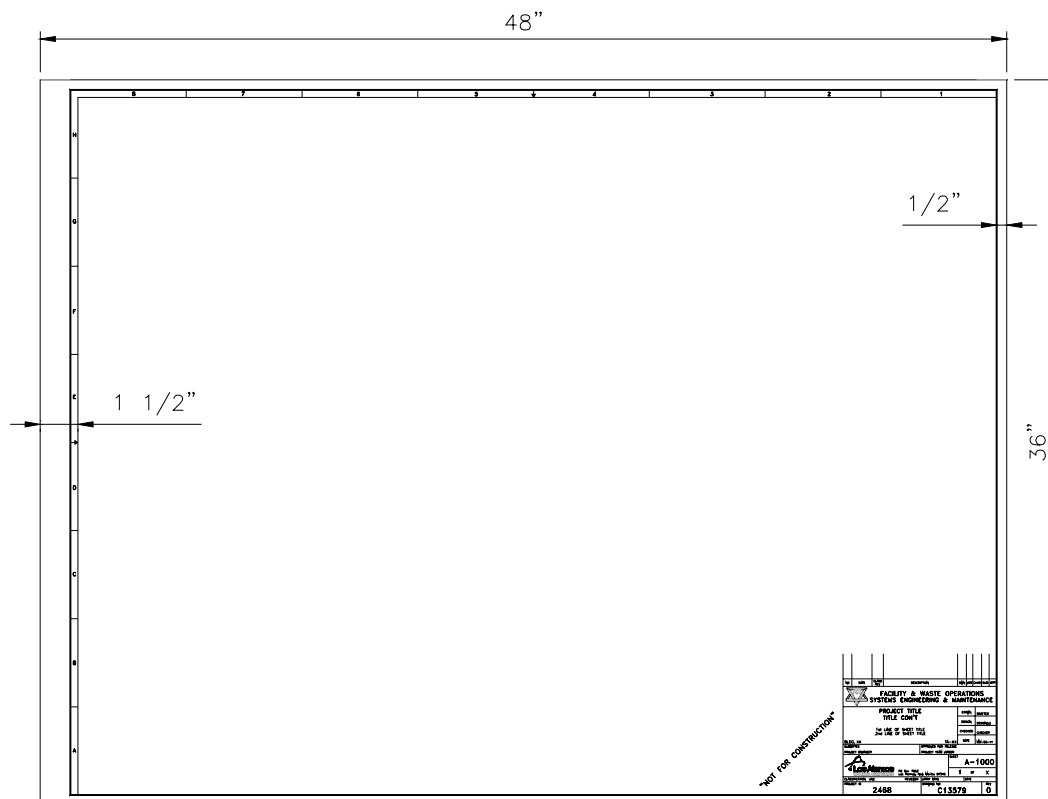


Figure 201-1



"E" SIZE

Figure 201-2

- G. "C" and "E" size sheets may be used for special projects not related to 1.0 A and B of this section. LANL project manager shall give guidance for determining sheet usage. (No construction drawings on "E" sized sheets.)

## 2.0 FINAL DRAWING SUBMITTAL

- A. Submit all drawings (initial issue and revisions) to FWO-SEM, CM Team for record keeping. Submit paper prints and electronic files as follows:
1. **Paper prints:** Full size, with all required signatures/initials signed off. Use black line on a minimum 0.003 inch paper thickness. Do not use stick-on, appliques, zip-a-tone, etc. on final drawing sheets.
  2. **Electronic files:** Refer to Section 215 for requirements.

### 3.0 “NOT FOR CONSTRUCTION” NOTATION

The note “NOT FOR CONSTRUCTION” is to be marked on all in-progress construction drawing sheets in a Construction Drawing Set. Do not remove this notation until the drawings are approved for final release. See Symbol block in [Appendix B](#), General.

Appearance	Font	Location
Letter size 1/4 inch	Romand	Left of the title block at a 45-degree angle, read from left to right

### 4.0 SEALED DRAWINGS

- A. Comply with the LANL Engineering Manual (LEM) for the requirements of sealing construction documents.
- B. The preferred (if required) location of the Engineer’s Stamp (seal) is to the “immediate left” of the title block just above the sheet border.

## 202 DRAWING TITLE BLOCKS

### 1.0 GENERAL

- A. Maintain consistency and accuracy in title block format and content throughout the Drawing Set.
- B. The extent of the drawing field and an example of the title block are shown below. *This allows for the consistent placement of notes, general notes, security classification stamps, and key plans. The preferred extent of the drawing field is illustrated, for clarity purposes only, with the dashed line.*
  1. Do not graphically show this border on the drawing

The figure shows a drawing template with a large rectangular area for the drawing, bounded by a dashed line. To the right of the drawing area is a title block. The title block contains the following sections:

- KEYED NOTES**: A section for keyed notes, indicated by a dashed line.
- GENERAL NOTES**: A section for general notes, indicated by a dashed line.
- PROJECT TITLE**: A section for the project title, indicated by a dashed line.
- 1st LINE OF SHEET TITLE**: A section for the first line of the sheet title, indicated by a dashed line.
- 2nd LINE OF SHEET TITLE**: A section for the second line of the sheet title, indicated by a dashed line.
- LOCATION FOR ENGINEERING STAMP**: A dashed line indicating the location for an engineering stamp.
- Table**: A table with the following columns: NO., DATE, CLASS, DESCRIPTION, and DRAWN BY. The table is currently empty.
- Los Alamos**: The Los Alamos National Laboratory logo.
- PROJECT NO.**: 2468
- CLASSIFICATION**: UNCLASSIFIED
- REVISION**: C13579
- DATE**: 10-29-01
- REV**: 0

Figure 202-1

## 2.0 TITLE BLOCK FOR CONSTRUCTION DRAWINGS

- A. The standard Title Block for construction drawings is shown in Figure 202-2. See Table 202-1 for legend and description of the required Title Block contents.


①	②	③	④	⑤	⑥	⑦	⑧	⑨
NO	DATE	CLASS REV	DESCRIPTION	DWN	VER	CHKD	SUB	APP
⑩ LOGO HERE								
⑪ -----				DRAWN		⑰		
⑫ -----				DESIGN		⑱		
⑬ -----				CHECKED		⑲		
⑭ -----				DATE		⑳		
BLDG. ⑮		SUBMITTED		TA-⑯		DATE ⑳		
⑳				APPROVED FOR RELEASE ㉑				
 ㉒ Los Alamos NATIONAL LABORATORY				SHEET		㉔		
PO Box 1663 Los Alamos, New Mexico 87545				㉕		OF ㉖		
CLASSIFICATION ㉗		REVIEWER ㉘		DATE ㉙		REV		
PROJECT ID ㉚		DRAWING NO ㉛		REV		㉜		

Figure 202-2

- B. Figure 202-3 is an example of the Title Block for construction drawings.



NO	DATE	CLASS REV	DESCRIPTION	DWN	VER	CHKD	SUB	APP
 FACILITY & WASTE OPERATIONS SYSTEMS ENGINEERING & MAINTENANCE								
CRAY Y-MP-90-4 INSTALLATION, LDCC				DRAWN		D RAFTER		
ONE LINE DIAGRAM AND GROUNDING LAYOUT				DESIGN		D ESIGN(s)		
BLDG. 1498				CHECKED		C HECKER		
SUBMITTED				DATE		1-31-01		
PROJECT ENGINEER				APPROVED FOR RELEASE		PROJECT TEAM LEADER		
 ㉒ Los Alamos NATIONAL LABORATORY				SHEET		E-6000		
PO Box 1663 Los Alamos, New Mexico 87545				10		OF 18		
CLASSIFICATION U		REVIEWER R VIEWER		DATE		REV		
PROJECT ID 10692		DRAWING NO C45972		REV		REV		

Figure 202-3

- C. Standard LANL Title Blocks have been created on the World Wide Web site listed in Appendix H ([http://www.lanl.gov/orgs/f/f6/pubf6stds/drftman/drft\\_symbols.html](http://www.lanl.gov/orgs/f/f6/pubf6stds/drftman/drft_symbols.html)).

**TABLE 202-1**  
**Construction Drawing Title Block Contents**

Item	Description	Character/ Size Font	Notes	Data Definition
1	Revision Number	3/32" romans		Number of revision made to the drawing.
2	Date of Revision	3/32" romans		Date the revision was made to the drawings.
3	Classification	3/32" romans	1, 4	The LANL ADC familiar with the project or area of construction will classify the revision and place his or her signature to the right of the classification in the revisions block (Item #4) with an explanation for the reclassification.
4	Revision Description	3/32" romans		A description of the changes made to the drawing, P.I. number, A/B date, etc.
5	Drawn	3/32" romans	1	Initials and/or last name of the designer/drafter.
6	Design	3/32" romans	1	Initials and/or last name of the designer/engineer.
7	Checked	3/32" romans	1	Initials and/or last name of the checker.
8	Submitted	3/32" romans	3, 5	Initials of the person in the design agency with the authority to release the drawings
9	Approved for Release	3/32" romans	3, 5	Initials of the LANL Project Leader or Facility Manager with final approval for release.
10	Drawing Originating Organization			The logo/name of the organization or firm doing the design.
11	Project Title	3/16" romans	2	A project title will be filled in for: new facility construction, new addition to an existing facility, the installation of a new system in an existing facility, or Standards Manual Drawing. No title descriptions are required, for modifications or upgrades to existing facilities or systems.
12	Project Title Line 2	3/16" romand	2	
13	Sheet Title	1/8" romand	2	A descriptive title of the information contained on the drawing sheet. Typically, the type of drawing (e.g., Process and Instrumentation Diagram)
14	Sheet Title Line 2	1/8" romand	2	Space for continuation of the Sheet Title. Typically, the detail information (e.g., Compressed Air system)
15	Building Number	1/8" romans		The unique identifying number for a building or structure within a designated technical area.
16	Technical Area	1/8" romans		The geographical area designation assigned to LANL properties.

Continued on next page

**TABLE 202-1**  
**Construction Drawing Title Block Contents (con't)**

Item	Description	Character/ Size Font	Notes	Data Definition
17	Drawn	3/32" romans	1	First initial and last name of the drafter/designer. (Not required for issuance after revision 0.)
18	Design	3/32" romans	1	First initial and last name of the designer/engineer. (Not required for issuance after revision 0.)
19	Checked	3/32" romans	1	First initial and last name of the person who checked the drawings, but not the same person who designed or produced the drawing. (Not required for issuance after revision 0.)
20	Date	3/32" romans	1	Date the final drawing set is issued. Date all sheets the same.
21	Submitted	3/32" romans	3, 5	Typed name and signature of the person at the design agency with the authority to release the documents.
22	Approved for Release	3/32" romans	3, 5	Typed name and signature of the LANL Project Team Leader or Facility Manager responsible for the project with the final approval for release.
23	Responsible Organization			Logo/name of the organization for whom the drawing is produced (LANL).
24	Discipline Sheet Number	3/16" for more than three characters romand		Alphanumeric characters sequentially numbered, by discipline through the project drawing set. Also see Section 211.
25	Project Sheet Number	3/16" Text height and 0.85 text width romand		A sequential number assigned to each drawing sheet in a project drawing set.
26	Number of sheets in a project drawing set	3/16" Text height and 0.85 text width romand		Total number of drawings in the project drawing set.

Continued on next page

**TABLE 202-1**  
**Construction Drawing Title Block Contents (con't)**

Item	Description	Character/ Size Font	Notes	Data Definition
27	Classification	3/32" romans	1, 4	The security classification of the drawing set uses a designation of: “ <b>U</b> ” for Unclassified; “ <b>OUO</b> ” for Official Use Only; “ <b>C</b> ” for Confidential; “ <b>UNCI</b> ” for Unclassified Controlled Nuclear Information; and, “ <b>S</b> ” for Secret. The LANL Authorized Derivative Classifier (ADC) can provide the classification requirements. For a drawing set that contains security information, each drawing shall be stamped with the classification with text of not less than 1/8”. Example: Appendix B symbol G39 UCNI stamp.
28	Classifier/ Reviewer	3/32" romans	1, 4	The signature or initial and name of the person authorized to classify drawings.
29	Classification Date	3/32" romans	4	Date of classification signature.
30	Project Identification Number	1/4" romand		A unique number assigned to a task by the LANL Computerized Maintenance Management System (CMMS). This number is used for projects that generate paper documents and record drawings to be placed in LANL FWO-SEM Records Center.

Continued on next page

**TABLE 202-1**  
**Construction Drawing Title Block Contents (con't)**

Item	Description	Character/ Size Font	Notes	Data Definition
31	Drawing Number "C"	1/4" romand		A unique number assigned to the drawing set by the FWO-SEM CM Team Office. It is an alphanumeric number with no spaces, dashes, or slashes; preceded by the capital letter "C." Used for: record drawings associated with new facility and additions to existing facility construction.
	Drawing Number "PL"	1/4" romand		A unique number assigned to the plate(s) (PL) set by the FWO-SEM CM Team Office. It is an alphanumeric number with no spaces, dashes, or slashes; preceded by the capital letters "PL."
	Drawing Number "SK"	1/4" romand		A unique number assigned to the sketch (SK) by the FWO-SEM CM Team Office. It is an alphanumeric number with no spaces, dashes, or slashes; preceded by the capital letters "SK."
	Drawing Number "ST"	1/4" romand		A unique number assigned to the standard drawing (ST) by the FWO-SEM CM Team Office. It is an alphanumeric number with no spaces, dashes, or slashes; preceded by the capital letters "ST."
32	Revision Number	1/4" romand		Number of revisions made to the drawing.

**Notes:**

1. Enter appropriate names and dates electronically. When issuing drawings for design review, initials or signatures are required for the checked, submitted, and classification blocks. For the final issue, initials or signatures are required above or alongside all printed names.
2. Do not underline titles or subtitles.
3. The title block contents (8, 9, 21 & 22) are an example of required approvals. The number and headings of approval signatures/initials shall be determined by the LANL Project Leader.
4.
  - a. This section of the title block must be filled in when the record document package is signed off for approval.
  - b. Follow LANL's S-7 Group requirements for review/signature.
  - c. *Guidance: Use an Authorized Derivative Classifier (ADC) associated and/or familiar with the project. The ADC should be contacted and informed about the project during the early stages of design development.*

Basis: DOE Order 475.1-1, Identifying Classified Information, which is part of the WSS, states in Chapter VI that:

“Review Requirements. Anyone who originates a document or material in a subject area that may be classified shall submit the document or material to the appropriate official for a classification review and determination prior to dissemination.

a.) Routine Document or Material. An employee with an active access authorization who originates a document or material in a subject area that may be classified shall submit the document or material to a Derivative Classifier for classification review prior to dissemination. An employee who had an active access authorization in the past shall submit such a document or material to the local Classification Officer for classification review prior to dissemination. The local Classification Officer may delegate this review responsibility to specified Derivative Classifiers.”


In addition, drawings placed on MOADS by FWO-SEM CM must be unclassified.


5. *Guidance: additional “submittal” or “approved” blocks may be added to suit project sign-off requirements.*

### **3.0 TITLE BLOCK AND DRAWING FORMATS FOR ENGINEERING STUDIES (ES), DESIGN CRITERIA (DC), AND CONCEPTUAL DESIGN REPORTS (CDR)**

- A. The drawings produced for Engineering Studies (ES), Design Criteria (DC) and Conceptual Design Reports (CDR) are not intended for use as construction documents; therefore, stamps and signatures are not required. The FWO-SEM, CM Team will enter title block information in its master database when record copy is received.
- B. Provide accurate and consistent information in the title block throughout the drawing set.
- C. Produce Engineering Studies, Design Criteria and Conceptual Design Report drawings on “D” size sheets and submit on 11" X 17" drawing (B size) sheets for binding or folding for insertion into the 8-1/2" X 11" (A size) report format.
- D. Convey the project information in the simple format illustrated below. For a description of the required Title Block Contents see Table 202-2.

- E. The following is an example of the Title Block format for the Studies and Reports (for a description of contents see Table 202-2).

A/E LOGO HERE		
PROJECT TITLE FIRST LINE		
SECOND LINE		
THIRD LINE		
SHEET TITLE		C-1010
SECOND LINE		
BLDG. 362		TA- 44
		
P.O. Box 1663 Los Alamos, New Mexico 87545		
PI 12345	DATE 1-1-2001	SHEET 1234

A/E LOGO HERE (11)		
(1)		
(2)		
(3)		
(4)		(5)
BLDG. 362 (6)		(7)
		
P.O. Box 1663 Los Alamos, New Mexico 87545		
PI (8)	DATE (9)	SHEET (10)

*Figure 202-4*

**TABLE 202-2**  
**Engineering Study, Design Criteria and Conceptual Design Report**  
**Title Block Contents**

Item	Description	Character/ Size Font	Notes	Data Definition
1	Project Title	1/8" romand	1	A descriptive name of the project. Project Title and Title Sheet required for new facility construction. Not required for modifications to existing facilities.
2	Project Title Line 2	1/8" romand	1	Space for continuation of the Project Title.
3	Project Title Line 3	1/8" romand	1	Space for continuation of the Project Title.
4	Sheet Title	3/32" romand	1	A descriptive title of the information contained on the drawing sheet. There are two lines for the sheet title. First line is generally the type of drawing (e.g., Process and Instrumentation Diagram), second line generally the specific information (e.g., Compressed Air System).
5	Discipline Sheet Number	3/16" romand		Alphanumeric character, sequentially numbered, by discipline through the project drawing set.
6	Building Number	1/16" romans		The unique identifying number for a building or structure within a designated technical area.
7	Technical Area	1/16" romans		The geographical area designated assigned to LANL properties.
8	Project Identification Number	1/16" romans		A unique number assigned to a task by the CMMS.
9	Date	1/16" romans		The date the drawing set is issued for review or as final. Use the same date for all sheets in the drawing set.
10	Sheet Number	1/16" romans		A unique plate # (PL#) number assigned by FWO-SEM CM Team Office.
11	Drawing Originating Organization	no requirement		The logo/name of the organization or firm doing the design.
12	Project Sheet Number/ number of sheets in a project drawing set	1/8"		A sequenced number assigned to each drawing sheet in a project drawing set, and the total number of drawings in a drawing set.

**Note:** Do not underline titles or subtitles.

## 203 TITLE SHEET

### 1.0 GENERAL REQUIREMENTS

- A. Provide a Title Sheet for drawings regardless of the number of drawing sheets in the drawing set.
- B. *Guidance: Title sheets are not required but recommended for Engineering Studies, Design Criteria, and Conceptual Design Reports.*

### 2.0 EXAMPLE OF TITLE SHEET

- A. The following graphic is an example of the Title Sheet for new projects (see Table 203-1 for content description). This Title Sheet (Appendix H) is found on the worldwide web site address: ([http://www.lanl.gov/orgs/f/f6/pubf6stds/draftman/draft\\_symbols.html](http://www.lanl.gov/orgs/f/f6/pubf6stds/draftman/draft_symbols.html))

8	7	6	5	4	3	2	1																																																																																																																																												
<h1 style="margin: 0;">PROJECT TITLE ①</h1> <h2 style="margin: 0;">BLDG 222 TA-44 ④</h2>						<div style="border: 1px solid black; width: 100px; height: 100px; margin: 0 auto; display: flex; align-items: center; justify-content: center;"> <span style="font-size: 24px;">②</span> </div>																																																																																																																																													
<div style="display: flex;"> <div style="flex: 1;"> <p><b>PROJECT DESIGN DATA</b></p> <p>ANY CODE ANALYSIS INFO THAT IS IMPORTANT TO THE DESIGN PROCESS SHALL BE DOCUMENTED HERE. EXAMPLES OF IMPORTANT INFO ARE:</p> <ul style="list-style-type: none"> <li>• OCCUPANCY CLASSIFICATION</li> <li>• TYPE OF CONSTRUCTION</li> <li>• BUILDING AREA</li> <li>• AREA SEPARATIONS</li> <li>• FLOOR &amp; ROOF LOADING</li> </ul> </div> <div style="flex: 1;"> <p><b>LIST OF DRAWINGS</b></p> <table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th>REVISION NUMBER</th> <th>SHEET NUMBER</th> <th>DISCIPLINE</th> <th>DRAWING TITLE</th> </tr> </thead> <tbody> <tr><td>1</td><td>1</td><td>G-0001</td><td>TITLE SHEET</td></tr> <tr><td>2</td><td>2</td><td>G-0002</td><td>SUBMITTAL SHEET</td></tr> <tr><td>3</td><td>3</td><td>C-0001</td><td>SYMBOL LEGEND AND GENERAL NOTES</td></tr> <tr><td>4</td><td>4</td><td>C-1000</td><td>SITE PLAN</td></tr> <tr><td>5</td><td>5</td><td>C-1002</td><td>GRADING PLAN</td></tr> <tr><td>6</td><td>6</td><td>C-1003</td><td>UTILITIES PLAN</td></tr> <tr><td>7</td><td>7</td><td>C-8000</td><td>DETAILS</td></tr> <tr><td>8</td><td>8</td><td>A-0001</td><td>SYMBOL LEGEND AND GENERAL NOTES</td></tr> <tr><td>9</td><td>9</td><td>A-1000</td><td>FIRST FLOOR PLAN</td></tr> <tr><td>10</td><td>10</td><td>A-1002</td><td>SECOND FLOOR PLAN</td></tr> <tr><td>11</td><td>11</td><td>A-2000</td><td>ELEVATIONS</td></tr> <tr><td>12</td><td>12</td><td>A-3010</td><td>SECTIONS</td></tr> <tr><td>13</td><td>13</td><td>A-6010</td><td>DETAILS</td></tr> <tr><td>14</td><td>14</td><td>A-6010</td><td>SCHEDULES: DOOR AND WINDOW</td></tr> <tr><td>15</td><td>15</td><td>A-7010</td><td>FINISH SCHEDULES</td></tr> <tr><td>16</td><td>16</td><td>P-0001</td><td>SYMBOL LEGEND AND GENERAL NOTES</td></tr> <tr><td>17</td><td>17</td><td>P-1001</td><td>SITE PLAN</td></tr> <tr><td>18</td><td>18</td><td>P-1002</td><td>FIRST FLOOR PLAN</td></tr> <tr><td>19</td><td>19</td><td>P-1002</td><td>SECOND FLOOR PLAN</td></tr> <tr><td>20</td><td>20</td><td>P-8000</td><td>SOMETHING: WASTE AND WATER</td></tr> <tr><td>21</td><td>21</td><td>P-8000</td><td>SCHEDULE</td></tr> <tr><td>22</td><td>22</td><td>M-0001</td><td>SYMBOL LEGEND AND GENERAL NOTES</td></tr> <tr><td>23</td><td>23</td><td>M-1000</td><td>FIRST FLOOR PLAN</td></tr> <tr><td>24</td><td>24</td><td>M-1010</td><td>SECOND FLOOR PLAN</td></tr> <tr><td>25</td><td>25</td><td>M-3000</td><td>ELEVATIONS</td></tr> <tr><td>26</td><td>26</td><td>M-3000</td><td>SECTIONS</td></tr> <tr><td>27</td><td>27</td><td>M-8000</td><td>DETAILS</td></tr> <tr><td>28</td><td>28</td><td>M-8000</td><td>PRIME AND INSTRUMENTATION DIAGRAM</td></tr> <tr><td>29</td><td>29</td><td>M-8010</td><td>SCHEDULES</td></tr> <tr><td>30</td><td>30</td><td>E-0001</td><td>SYMBOL LEGEND AND GENERAL NOTES</td></tr> <tr><td>31</td><td>31</td><td>E-1000</td><td>FIRST FLOOR PLAN</td></tr> <tr><td>32</td><td>32</td><td>E-1010</td><td>SECOND FLOOR PLAN</td></tr> <tr><td>33</td><td>33</td><td>E-4000</td><td>ONE LINE DIAGRAM</td></tr> <tr><td>34</td><td>34</td><td>E-7000</td><td>SCHEDULES</td></tr> </tbody> </table> </div> </div>						REVISION NUMBER	SHEET NUMBER	DISCIPLINE	DRAWING TITLE	1	1	G-0001	TITLE SHEET	2	2	G-0002	SUBMITTAL SHEET	3	3	C-0001	SYMBOL LEGEND AND GENERAL NOTES	4	4	C-1000	SITE PLAN	5	5	C-1002	GRADING PLAN	6	6	C-1003	UTILITIES PLAN	7	7	C-8000	DETAILS	8	8	A-0001	SYMBOL LEGEND AND GENERAL NOTES	9	9	A-1000	FIRST FLOOR PLAN	10	10	A-1002	SECOND FLOOR PLAN	11	11	A-2000	ELEVATIONS	12	12	A-3010	SECTIONS	13	13	A-6010	DETAILS	14	14	A-6010	SCHEDULES: DOOR AND WINDOW	15	15	A-7010	FINISH SCHEDULES	16	16	P-0001	SYMBOL LEGEND AND GENERAL NOTES	17	17	P-1001	SITE PLAN	18	18	P-1002	FIRST FLOOR PLAN	19	19	P-1002	SECOND FLOOR PLAN	20	20	P-8000	SOMETHING: WASTE AND WATER	21	21	P-8000	SCHEDULE	22	22	M-0001	SYMBOL LEGEND AND GENERAL NOTES	23	23	M-1000	FIRST FLOOR PLAN	24	24	M-1010	SECOND FLOOR PLAN	25	25	M-3000	ELEVATIONS	26	26	M-3000	SECTIONS	27	27	M-8000	DETAILS	28	28	M-8000	PRIME AND INSTRUMENTATION DIAGRAM	29	29	M-8010	SCHEDULES	30	30	E-0001	SYMBOL LEGEND AND GENERAL NOTES	31	31	E-1000	FIRST FLOOR PLAN	32	32	E-1010	SECOND FLOOR PLAN	33	33	E-4000	ONE LINE DIAGRAM	34	34	E-7000	SCHEDULES	<p><b>LOCATION PLAN</b> SCALE: NONE TA-44</p> <p><b>PRODUCT OPTIONS/SUBSTITUTIONS</b> "OR APPROVED EQUAL" IS ALWAYS IMPLIED AFTER A BRAND NAME. PATENTED PROCESS OR CATALOG NUMBERS. THE CONTRACTOR MAY SUBSTITUTE ANY BRAND, PROCESS OR CATALOG NUMBER APPROVED AS AN EQUAL BY THE CONTRACT ADMINISTRATION. THE ONLY EXCEPTION IS BRIDGE. NO SUBSTITUTION IS SPECIFIED. SEE GENERAL PROVISION "MATERIAL AND WORKMANSHIP".</p>	
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Figure 203-1

**TABLE 203-1  
Title Sheet Contents**

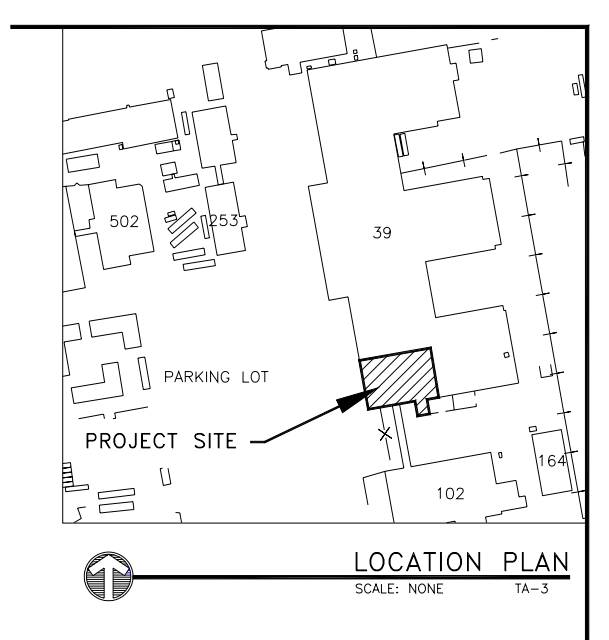
<b>Item</b>	<b>Description</b>	<b>Character/ Size Font</b>	<b>Data Definition</b>
1	Project Title	1 inch, Romand, double underline 0.50 mm line width, color 1, continuous	The descriptive name of the project. Project title and title sheet required for new facility construction. Not required for modifications to existing facilities.
2	Location Plan	No scale	A plan that illustrates the location of the project - see Figure 203-1.
3	Building Number	1/2 inch, Romand, double underline 0.50 mm line width, color 1, continuous	The unique identifying number for a building or structure within a designated technical area.
4	Technical Area	1/2 inch, Romand, double underline	The geographical area designation assigned to LANL properties.
5	Project Design Data	1/8 inch Romans	This information is required - usually pertinent code analysis information is inserted here. Reference the code used and date of the code. (See LANL Engineering Manual, Chapter 4 - Architectural, Project Design Data.)
6	List of Drawings	1/4 inch Romand, single underline 0.50 mm line width, color 1, continuous	The header for the Drawing List.
7	Product Options and Substitution Statement	1/8 inch, Romans	A brief LANL procurement policy statement - see subpart 4.0 herein.
8	Sheet Number	1/8 inch Romand	The column header for the list of drawings sheet numbers.
9	Discipline Sheet Number	1/8 inch Romand	The column header for the list of drawings discipline sheet numbers.
10	Drawing Title/Header	1/8 inch Romand	List of the drawing sheet titles - show exactly as they appear in the title blocks of the drawing sheets.
11	Sheet Number	1/8 inch Romans	The number shown in the title block of each drawing sheet.
12	Discipline Sheet Number	1/8 inch Romans	The number shown in the title block of each discipline drawing sheet.
13	Drawing Titles	1/8 inch Romans	List of drawing sheet titles - show exactly as they appear in the title blocks of the drawing sheets.
14	Title Block	-	See Section 202.
15	Revision Column	1/8 inch Romans	The column header for the list of revisions that affect the drawing sheets.
16	Date Stamp	3/32" Romans	This stamp will assist in drawing file management, locating projects and data

**Note:** All entries on the title sheet will be on layer: text, color: white, 0.35 mm pen width (0.015").

### 3.0 LOCATION PLAN

A Location Plan is an area map that graphically illustrates the general location, by technical area, where the construction is planned.

- A. All drawing sets are required to have a Location Plan.
- B. Locate this plan on the Title Sheet in the upper right hand corner of the sheet (Fig. 203-1), as illustrated in Figure 203-2. The plan and all text shall not cover more than a 7.5" x 7.5" square.
- C. Show enough of the surrounding areas (streets, buildings, structures, etc.) to clearly identify the project location.
- D. Orient the Location Plan on the drawing sheet so that the north arrow points to the top of the sheet, as illustrated.
- E. An electronic or hard copy Location Plan can be obtained from the FWO-SEM CM Team or the Support Services Subcontractor "As-Built" program for various Technical Areas within the LANL boundary.



*Figure 203-2*

- F. The borderline around the location plan shall be 0.50 mm line width.
- G. Text requirements:

Project Site	3/16 inch romand
Location Plan	1/4 inch romand
TA	1/8 inch romans
All on Color: 7, Layer: Text	

#### 4.0 PRODUCT OPTIONS AND SUBSTITUTIONS

**Note:** This block is only required on projects without a specification package.

1. Enter the substitution statement exactly as stated in Section [01630](#) of the LANL Construction Specifications, layer: text.
2. The following is the wording from Section 01630 as of July 2001:

***PRODUCT OPTIONS AND SUBSTITUTIONS***

*(3/16" text height, Romand)*

"Or approved equal" is always implied after a brand name, patented process or catalog number. The contractor may substitute any brand or process approved as an equal by specifying Architect/Engineer. The only exception is where "no substitution" is specified. See General Provision "Material and Workmanship."

*(1/8" text height, romans)*

3. For location of this block see Section 203, subpart 2.0, Example of Title Sheet.

## 204 PLAN ORIENTATION

### 1.0 GENERAL

- A. Except for Civil Plan and Section (profile) drawings, comply with the following for plan orientation on drawing sheets. *Guidance: Whenever possible orient the site plan in the same manner as the floor plan.*
1. Place the principal plans on the drawing sheet with the building lines parallel to the sheet borders.
  2. Orient all principal plans in the drawing set identically for continuity and clarity.
  3. Orient the plans on the drawing sheet so that the north arrow is pointing in the direction of either the upper left or upper right quadrants of the sheet.

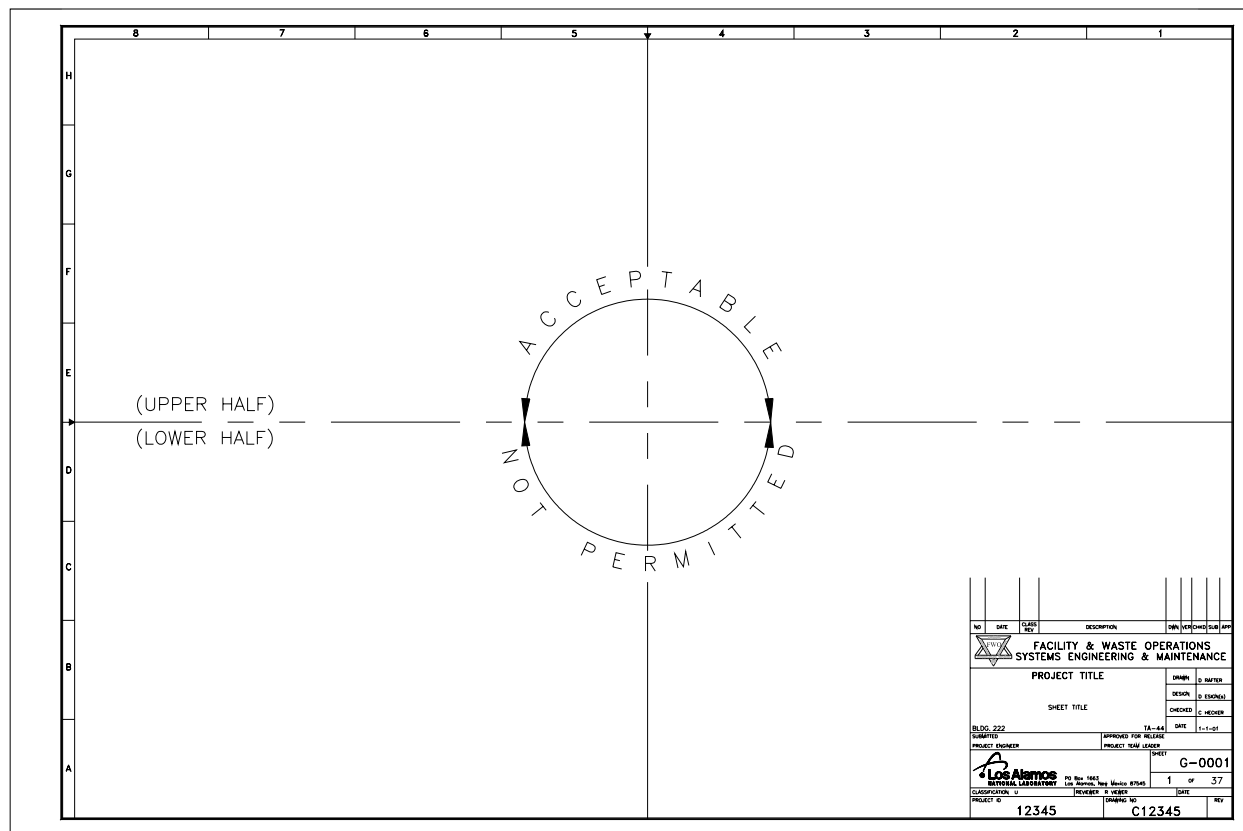
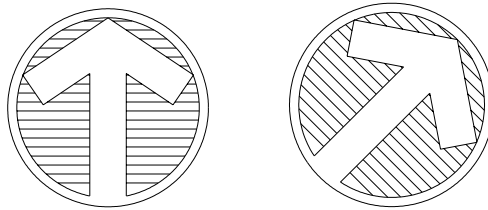


Figure 204-1

## **205 NORTH ARROW SYMBOL**

### **1.0 EXAMPLES OF NORTH ARROW**

The graphic below is the required North Arrow (“True North”) and is located as a block (G01), Appendix B, General Graphic Symbols.



*Figure 205-1*

### **2.0 GENERAL REQUIREMENTS FOR NORTH ARROW**

- A. Place of the North Arrow symbol is at the left end of the horizontal line under the title.
- B. For “C,” “D,” and “E” size sheets make the circle 5/8 inches. For “A” and “B” size sheets make the circle 5/16 inches.

## 206 PARTIAL PLANS

### 1.0 KEY PLANS

- A. Use a small scale "key plan" for each drawing sheet on which a partial plan appears.
- B. Clearly indicate on the "key plan" where the partial plan occurs in the overall building layout.
- C. Orient partial plans and key plans identically.
- D. Locate the "key plan" in the upper right hand corner of the sheet and occupy a space no larger than a 5" x 5" square including all text.

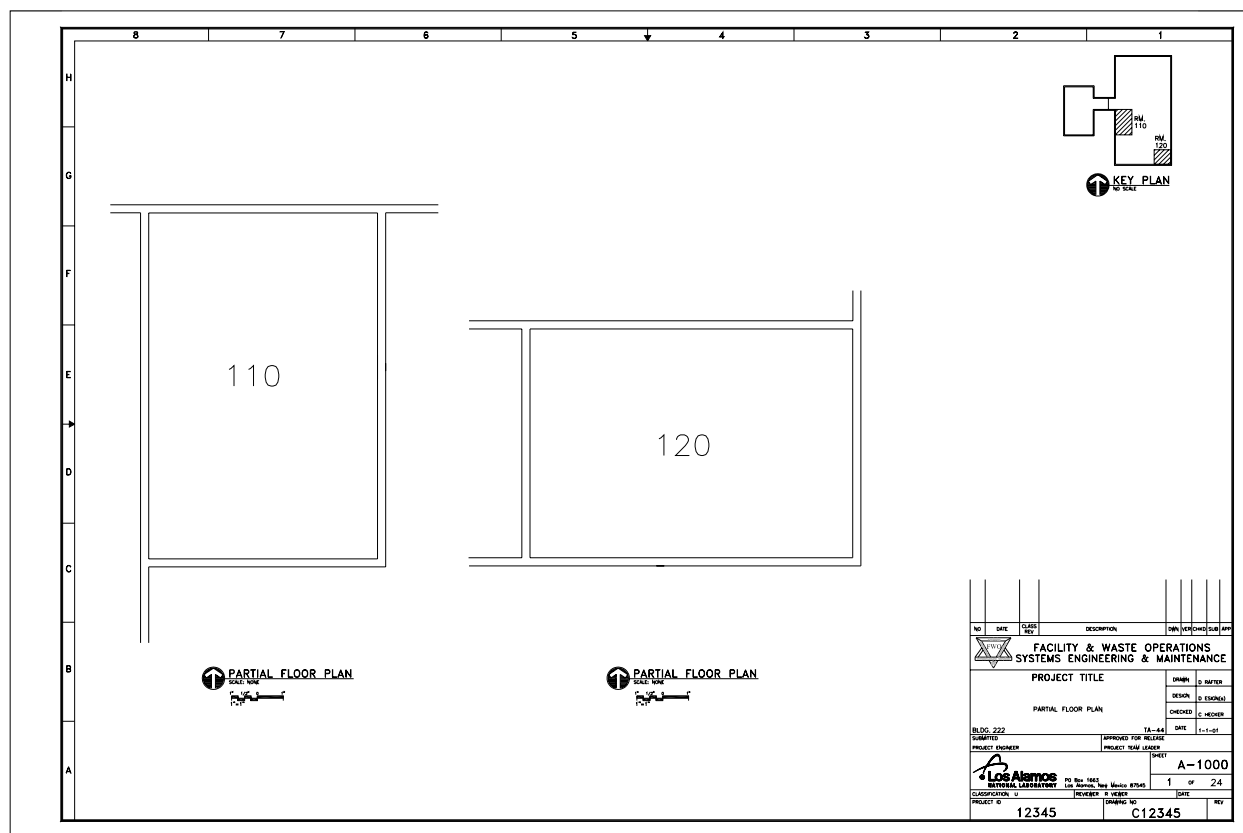


Figure 206-1

## 2.0 MATCH LINES

- A. When a plan is too large for one drawing sheet, divide the plan into logical sections.
- B. Provide a match line that is 0.80 mm (0.031") thick, phantom line type.
- C. Use a 1/4" text height, romand font, 0.50 mm line width to clearly indicate where the plan continues on another sheet, as illustrated below.
- D. Use a key plan (see Figure 206-1).

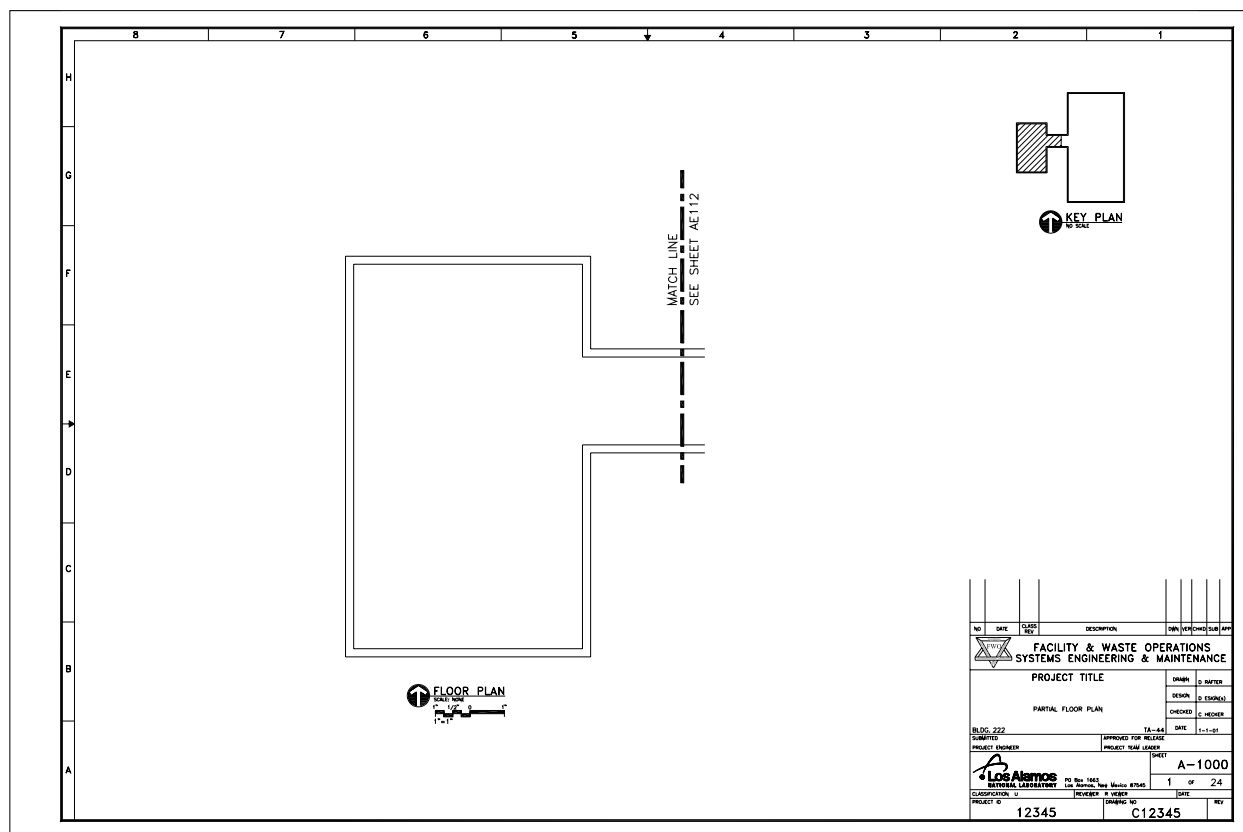


Figure 206-2

## **207 SUBMITTAL SHEET**

### **1.0 CRITERIA AND GUIDELINES FOR SUBMITTAL SHEET**

*It is strongly recommended that LANL Construction Specifications Section [01300](#), Submittals, be used. In all contract packages alternatively include a submittal sheet (General Information “G” Sheet) in the drawing set when submittals are required but when a specification package is not included with the construction documents. Use the following guidelines in producing the submittal sheet and stating the submittal requirements:*

- A. Produce a Submittal Schedule and Definition of Submittal Types on the “G” sheet (See Figure 207-1).
- B. Do not place submittal lists on any of the discipline sheets.

### **2.0 NUMBERING THE REQUIRED SUBMITTALS**

- A. Assign each submittal an alphanumeric designation using no more than 3 characters. This alphanumeric designation is the “SUB NO.” in the submittal schedule illustrated on the following page.
- B. An alphanumeric designation represents the discipline requiring the submittal. Assign an alpha character representing the discipline using Section 210, Drawing Set Organization, as a guideline.
- C. Assign a sequential number designation to the submittal by discipline.

### **3.0 SUBMITTAL SCHEDULE**

The schedule is a General Symbols block (G44), found in [Appendix B](#) of this manual and LANL Construction Specifications, Section [01300](#).

### **Example of Submittal Sheet**

[illegible]

## DEFINITIONS OF SUBMITTAL TYPES

CA. CALCULATIONS

THE METHODS AND RESULTS OF CALCULATIONS IN DOCUMENTED FORM WHERE SPECIFIED.

CD. CATALOG DATA

STANDARD PRINTED INFORMATION ON MATERIALS, PRODUCTS, AND SYSTEMS, WHICH SHOWS PERFORMANCE CHARACTERISTICS, DIMENSIONS, MATERIAL OF FABRICATION, AND OTHER CHARACTERISTICS NECESSARY TO ASSURE CONFORMITY WITH THE DESIGN REQUIREMENTS. WHERE OTHER ITEMS OR INFORMATION NOT RELATED TO THE WORK OF THIS PROJECT ARE INCLUDED IN THE LITERATURE SUBMITTED, THE ITEM(S) AND/OR INFORMATION APPLICABLE TO THIS PROJECT SHALL BE CLEARLY MARKED.

CT. CERTIFICATIONS

A WRITTEN STATEMENT, SIGNED BY A QUALIFIED PARTY, ATTESTING THAT ITEMS OR SERVICES ARE IN ACCORDANCE WITH SPECIFIED REQUIREMENTS. TYPICALLY, THIS WRITTEN STATEMENT IS ACCOMPANIED BY ADDITIONAL INFORMATION TO SUBSTANTIATE THE STATEMENT.

## II. INSTALLATION INSTRUCTIONS

MANUFACTURER'S INSTRUCTIONS, STEP-BY-STEP IF NECESSARY, SHOWING THE FIELD INSTALLATION OF PARTS, COMPONENTS, EQUIPMENT AND OTHER SIMILAR ITEMS.

ML. MATERIAL LIST/PARTS LIST/DESIGN MIXES

A LIST OF SYSTEM COMPONENTS OR MATERIAL COMPONENTS.

PD. PERFORMANCE CURVES/DATA

PERFORMANCE CURVES AND/OR DATA FOR THE SELECTED EQUIPMENT TO SHOW COMPLIANCE WITH CONTRACT DOCUMENTS.

SC. SAMPLES/COLORS

SAMPLES, INCLUDING COLORS OF PROPOSED MATERIALS.

SD. SHOP DRAWINGS

DRAWINGS NECESSARY TO SHOW FABRICATION DETAILS TO ENSURE COMPLIANCE WITH CONTRACT DOCUMENTS.

TR. TEST REPORTS

RESULTS OF SPECIFIED TEST REQUIREMENTS.

## WD. WIRING DIAGRAMS

DRAWINGS SHOWING THE POINT-TO-POINT WIRING OF A PIECE OF EQUIPMENT OR BETWEEN PIECES OF EQUIPMENT IN A SYSTEM.

OM, SP.  
& WA O&M MANUALS/SPARE PARTS LIST/WARRANTIES

MAINTENANCE SUBMITALS SHALL INCLUDE BOTH MAINTENANCE AND OPERATING MANUALS. INCLUDE EMERGENCY INSTRUCTIONS, SPARE PARTS LISTINGS, WARRANTIES, WIRING DIAGRAMS, RECOMMENDED "TURN-AROUND" CYCLES, INSPECTION PROCEDURES, SHOP DRAWINGS, PRODUCT DATA, AND SIMILAR INFORMATION AS APPLICABLE.

## RD. PROJECT RECORD DOCUMENTS

AS-BUILT DRAWINGS: A SET OF RED LINED PRINTS NOTING ALL DEVIATIONS FROM THE CONSTRUCTION DRAWINGS.

*Figure 207-1*

## 208 DRAWING SCALES AND TOLERANCES

### 1.0 GRAPHIC SCALES

- A. When drawings are produced to scale, insert graphic scales illustrating the drawing scale. Use these formats for standard graphic scales: (Refer to [Appendix B](#))

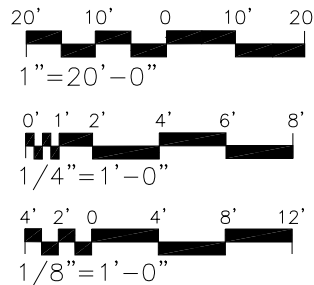


Figure 208-1

- B. In the illustration above, 3/32" text (the minimum allowable) is shown for the distance designations for all graphic scales because of the limited space available. The drawing scale designation text is shown at 1/8". These text heights were selected for graphic clarity. Graphic scales are to be centered and 1/4" below the drawing title, see Figure 206-1 and 206-2 for examples.
- C. Include the following statement as a General Note on the drawing sheet:
- "If this sheet is not (state the original plot size, i.e., 24" x 36"), then it is a reduced size plot. Use graphic scale accordingly."

### 2.0 DRAWING SCALES

Acceptable drawing scales and the call out protocol for drawings are as follows:

<u>Item</u>	<u>Scale</u>	<u>Item</u>	<u>Scale</u>
Site Plans:	1" = 10'	Profiles:	1" = 20'
	1" = 20'	Horizontal Scale:	1" = 10'
	1" = 50'	Vertical Scale:	1" = 5'
	1" = 100'		
Utility Plans:	1" = 10'	Sections:	1/8" = 1'-0"
	1" = 20'		1/4" = 1'-0"
	1" = 50'		1/2" = 1'-0"
	1" = 100'		3/4" = 1'-0"
			1" = 1'-0"

(Continued on next page)

<u>Item</u>	<u>Scale</u>	<u>Item</u>	<u>Scale</u>
Floor Plans and Elevations:	1/16" = 1'-0"	Partial Plans:	1/4" = 1'-0"
	1/8" = 1'-0"		1/2" = 1'-0"
	1/4" = 1'-0"		
Details:	1/2" = 1'-0"		
	3/4" = 1'-0"		
	1" = 1'-0"		
	1 1/2" = 1'-0"		
	3" = 1'-0"		

### 3.0 CONSISTENCY OF DRAWING SCALES

Draw all principal plans in a drawing set at the same scale.

### 4.0 EQUIPMENT ROOM DRAWING SCALES

- A. Layout all equipment, piping, conduits, trays, ducts, wiring, etc., located within the equipment rooms on an enlarged partial floor plan shown at 1/4" = 1' - 0" scale minimum.
- B. In rooms, areas, and spaces that are designed to accommodate equipment, show the equipment layout in detail plans, interior elevations and sections, as required for clarity.
- C. Use enlarged sections and details to show congested areas at minimum scale of 1/2" = 1' - 0" for clarity.

### 5.0 NO SCALE DRAWINGS

Certain details, diagrams, and plans cannot or need not be drawn to a specific scale (i.e., wiring, P&IDs, schematics, and control diagrams). For the drawing scale notation type "SCALE: NONE" indicating that no scale was used in generating the drawing.



Figure 208-2

### 6.0 TOLERANCES

*Guidance: Tolerances should be noted per ANSI Y14.5 - 1994, "Dimensioning and Tolerancing for Engineering Drawings (inches)," and client design criteria.*

## **209 DIMENSIONING**

### **1.0 GENERAL**

- A. Specify dimensions of less than one foot in inches, for example:

11 1/2"

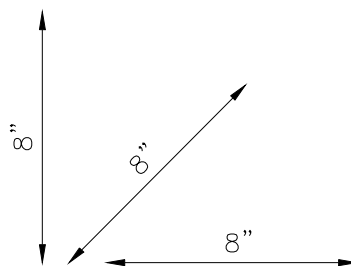
- B. Specify dimensions one foot and over in feet and inches, for example:

2' - 6 1/4"

- C. Exception to these rules occurs when dimensioning civil drawings, mechanical ductwork and piping, electrical control cabinets and boxes, or architectural woodwork.

### **2.0 DIMENSION LINE CONVENTION AND TEXT ORIENTATION**

- A. Use unbroken dimension lines with the dimension text located above the line. All dimension text must be read from the bottom or right side of the drawing sheet.



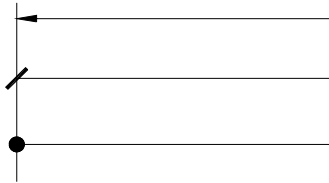
*Figure 209-1*

- B. *Guidance: For examples of text orientation for isometric drawings refer to: Global Engineering Documents, current edition, Section 3 and 4; DOE Handbook 1016, or AIA Architectural Graphic Standards.*

### **3.0 DIMENSION LINE TERMINATION**

- A. Arrowheads, slashes, and dots are all acceptable terminators for dimension lines.

- B. Draw a heavy terminator (arrowhead 1/8" in length, 45 degree diagonal, 0.80 mm line width tic mark, or 1/16" diameter solid circle) to ensure readability when reproduced or reduced to half size. Use a consistent terminator throughout all drawing sheets for a discipline in a drawing set. AutoCAD setting for terminator to be 1/8 inch.

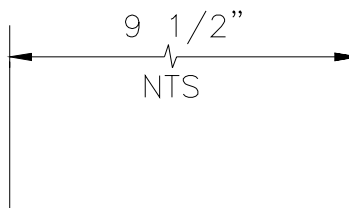
*Figure 209-2*

## 4.0 PLAN DIMENSIONS

- A. *Keep dimension lines clear of the building footprint whenever possible.*
- B. *Place dimension lines in a logical progression (i.e., centerlines, projections, overall, etc.).*
- C. *Keep the dimensions consistent on all plans.*
- D. *Tie all building portions together clearly.*
- E. *Do not dimension to hidden features.*
- F. *Refer to the National CAD Standards Manual Drafting Conventions, current edition, for hierarchy of dimensioning.*

## 5.0 DIMENSIONS NOT TO SCALE

When dimensional changes are made on drawings that affect the dimensions shown on a detail, it is not necessary to change the detail to agree with the new dimension. Change the dimension text to match the new dimension and note "NTS" below the dimension line, to indicate "Not to Scale" as illustrated below.

*Figure 209-3*

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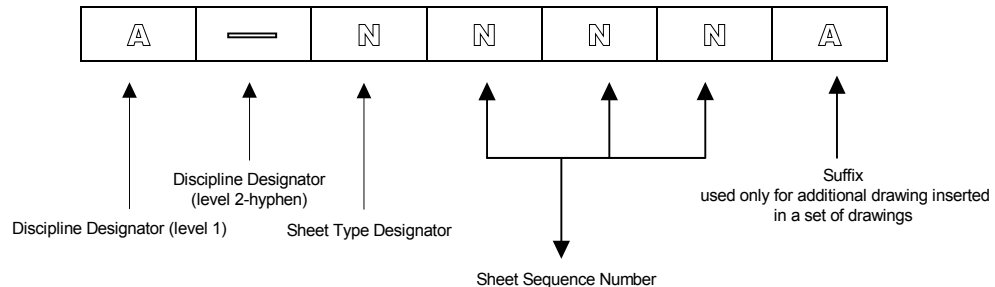
**RECORDS OF REVISION**

<b><u>Rev.</u></b>	<b><u>Date</u></b>	<b><u>Description</u></b>	<b><u>POC</u></b>	<b><u>OIC</u></b>
0	06/29/99	Document rewritten and reformatted to support LIR 220-03-01. This chapter supersedes LANL Facility Engineering Standards Drafting Manual, Vol. 2, Rev. 7, dated 4/17/98.	Danny Nguyen, <i>PM-2</i>	Dennis McLain, <i>FWO-FE</i>
1	10/29/01	Discipline ID & sheet numbering changed to NCS; text standardized; electronic file naming convention expanded & defined.	Richard Trout, <i>FWO-SEM</i>	Mitch S. Harris, <i>FWO-SEM</i>

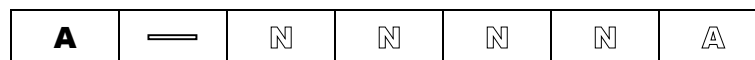
## 210 DRAWING SET ORGANIZATION

### 1.0 STANDARD SHEET IDENTIFICATION (NUMBERING)

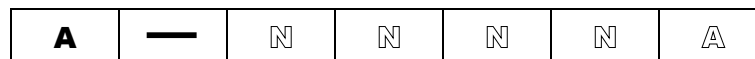
The required sheet identification format is applicable to all drawing production. It is consistent, yet flexible enough for a wide range of project scopes. The Uniform Drawing System (UDS) by the Construction Specifications Institute (CSI) sheet identification format depicted here has three components:



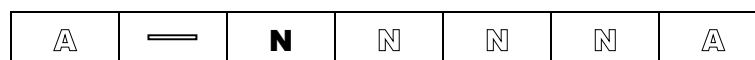
**LEVEL 1: Discipline designator**, consisting of 1 alphabetical character,



**LEVEL 2: Discipline designator**, is not used, replace with a hyphen,



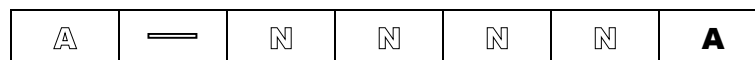
The **Sheet Type Designator**, identifies the type of information on the sheet and is followed by the **Sheet Sequence number**. **Sheet Type designator**, consisting of 1 numerical character,



**Sheet Sequence number**, consisting of 3 numerical characters.



**Supplemental Drawing Sheet**



The one-character **Discipline designator** identifies the sheet as a member of a subset.

Within the discipline designator, the first character is the discipline character, and the second is the modifier character. The discipline character identifies the creator of the drawings on the sheet. The modifier character is used to further subdivide the information for a specific use or purpose (i.e., M-1001 = Mechanical, Plan, Sheet 001). Refer to Uniform Drawing System Module 1 for further information.

## 2.0 LEVEL 1 - DISCIPLINE DESIGNATOR

The first component of the sheet identification format, the discipline designator, is based on the traditional system of alphabetical discipline designators.

A. Organize the drawing sets by discipline in the following order (as applicable):

Order Sequence	Discipline Code	Discipline
1	G	General (Title Sheet, General Notes, Scope of Work, Submittals)
2	H	<sup>1</sup> Hazardous Materials
3	V	Survey/Mapping
4	B	Geotechnical
5	W	<sup>1</sup> Civil Works (User Defined)
6	C	Civil
7	L	<sup>1</sup> Landscape
8	S	Structural
9	A	Architectural
10	I	Interiors
11	Q	Equipment (laboratory, food service parking lot, site)
12	F	Fire Protection
13	P	Plumbing
14	D	<sup>2</sup> Process (e.g., gloveboxes and process piping to and from gloveboxes), fumehoods and process equipment
15	M	Mechanical
16	E	Electrical
17	T	Telecommunications
18	D	<sup>1</sup> Resources
19	R	Other Disciplines (i.e., Safeguards & Security)
20	X	<sup>1</sup> Contractor/Shop Drawings
21	O	Operations

<sup>1</sup> Uniform Drawing System (UDS) discipline code not used at LANL.

<sup>2</sup> UDS discipline code modified for LANL application.

### 3.0 SHEET TYPE DESIGNATOR

- A. The second component of the sheet identification format is the sheet type designator. The sheet type is identified by a single numerical character. All sheet types may not apply to all discipline designators. It is not necessary to use all the sheet types for a project or within a discipline.
- B. Organize the Sheet Types in the following order (as applicable):

**TABLE 210-1**

<b>0</b>	<b>General</b> (symbols legend, notes, etc.)
<b>1</b>	<b>Plans</b> (horizontal views)
<b>2</b>	<b>Elevations</b> (vertical views)
<b>3</b>	<b>Sections</b> (sectional views)
<b>4</b>	<b>Large Scale views</b> (plans, elevations, or sections that are not details)
<b>5</b>	<b>Details</b>
<b>6</b>	<b>Diagrams</b>
<b>7</b>	<b>Schedules</b>
<b>8</b>	<b>User Defined</b> (for types which do not fall in other categories)
<b>9</b>	<b>3D Representations</b> (isometrics, perspectives, models, and photographs)

### 4.0 SHEET SEQUENCE NUMBER

- A. The third component of the sheet identification format is a three-digit sheet sequence number that identifies each sheet in a series of the same discipline and sheet type. The first sheet of each series is number **001**, followed by **002** through **0999**. (A three (3) - digit sequence number is required for efficient electronic file sorting and facility management databases.)

A	—	N	N	N	N	A
---	---	---	---	---	---	---

- B. On plan sheets, it may be desirable to replicate the floor name within each discipline. This makes sheets **A-1002**, **M-1002**, and **E-1002** the second floor plan for each of the various disciplines. This system may become cumbersome when basements and mezzanines or split level plans are involved. Evaluate each project carefully before deciding to implement this option.
- C. Additional drawings inserted in a set of drawings after a sheet identification organization has already been established can be identified with a suffix. *This suffix may be comprised of a defined designator; starting with the letter "A."*

## 211 ARRANGEMENT AND NUMBERING SEQUENCE

### 1.0 DRAWING SETS

- A. Shall be arranged in a defined order and assigned a unique number, within each discipline, as specified in Table 211-1.

**Note:** Drawing sets will not always include all of the types of drawings listed below, and show the commonly used disciplines:

**TABLE 211-1**

Discipline	Numbering Sequence	Order of Drawings
<b>(G) General</b>	0001 - 0999	General (Title Sheet, Legend, General Notes; Scope of Work, and Construction Sequence, Orientation Maps)
<b>(V) Survey / Mapping</b>	0001 - 0999	General (Legend, General Notes; Scope of Work, and Construction Sequence)
	1000 - 1999	Plans, (Demolition/New Construction), Boundary, Contour, Archaeological, and historical features
	2000 - 2999	Elevations
	3000 - 3999	Sections
	4000 - 4999	Large Scale Views (Plans, Elevations, or Sections that are not details)
	5000 - 5999	Details
	6000 - 6999	Diagrams
	7000 - 7999	Schedules
	8000 - 8999	User Defined
	9000 - 9999	3D Representation (isometrics, perspectives, photographs)
<b>(B) Geotechnical</b>	0001 - 0999	General (Legend, General Notes; Scope of Work, and Construction Sequence)
	1000 - 1999	Plans (Demolition/New Construction)
	2000 - 2999	Elevations
	3000 - 3999	Sections
	4000 - 4999	Large Scale Views (Plans, Elevations, or Sections that are not details)
	5000 - 5999	Details
	6000 - 6999	Diagrams
	7000 - 7999	Schedules
	8000 - 8999	User Defined
	9000 - 9999	3D Representation (isometrics, perspectives, photographs)

<b>Discipline</b>	<b>Numbering Sequence</b>	<b>Order of Drawings</b>
<b>(C) Civil</b>	0001 - 0999	General (Legend, General Notes; Scope of Work, and Construction Sequence)
	1000 - 1999	Plans (Site, Grading, Utility, Soil Boring logs, Plan & Profile, Demolition/New Construction)
	2000 - 2999	Elevations
	3000 - 3999	Sections
	4000 - 4999	Large Scale Views (Plans, Elevations, or Sections that are not details)
	5000 - 5999	Details
	6000 - 6999	Diagrams
	7000 - 7999	Schedules
	8000 - 8999	User Defined
	9000 - 9999	3D Representation (isometrics, perspectives, photographs)
<b>(S) Structural</b>	0001 - 0999	General (Legend, General Notes; Scope of Work, and Construction Sequence)
	1000 - 1999	Plans (Demolition/New Construction)
	2000 - 2999	Elevations
	3000 - 3999	Sections
	4000 - 4999	Large Scale Views (Plans, Elevations, or Sections that are not details)
	5000 - 5999	Details
	6000 - 6999	Diagrams
	7000 - 7999	Schedules
	8000 - 8999	User Defined
	9000 - 9999	3D Representation (isometrics, perspectives, photographs)
<b>(A) Architectural</b>	0001 - 0999	General (Legend, General Notes; Scope of Work, and Construction Sequence)
	1000 - 1999	Plans (Demolition than new construction)
	2000 - 2999	Elevations
	3000 - 3999	Sections
	4000 - 4999	Large Scale Views
	5000 - 5999	Details
	6000 - 6999	Diagrams
	7000 - 7999	Schedules
	8000 - 8999	User Defined
	9000 - 9999	3D Representation (isometrics, perspectives, photographs)

<b>Discipline</b>	<b>Numbering Sequence</b>	<b>Order of Drawings</b>
<b>(I) Interiors</b>	0001 - 0999	General (Legend, General Notes; Scope of Work, and Construction Sequence)
	1000 - 1999	Plans (Demolition/New Construction)
	2000 - 2999	Elevations
	3000 - 3999	Sections
	4000 - 4999	Large Scale Views (Plans, Elevations, or Sections that are not details)
	5000 - 5999	Details
	6000 - 6999	Diagrams
	7000 - 7999	Schedules
	8000 - 8999	User Defined
	9000 - 9999	3D Representation (isometrics, perspectives, photographs)
<b>(Q) Equipment</b>	0001 - 0999	General (Legend, General Notes; Scope of Work and Construction Sequence)
	1000 - 1999	Plans (Demolition & New Construction)
	2000 - 2999	Elevations
	3000 - 3999	Sections
	4000 - 4999	Large Scale Views
	5000 - 5999	Details
	6000 - 6999	Diagrams
	7000 - 7999	Schedules
	8000 - 8999	User Defined
	9000 - 9999	3D Representation (isometrics, perspectives, photographs)
<b>(F) Fire Protection</b>	0001 - 0999	General (Legend, General Notes; Scope of Work and Construction Sequence)
	1000 - 1999	Plans (Demolition & New Construction)
	2000 - 2999	Elevations
	3000 - 3999	Sections
	4000 - 4999	Large Scale Views
	5000 - 5999	Details
	6000 - 6999	Diagrams
	7000 - 7999	Schedules,
	8000 - 8999	User Defined
	9000 - 9999	3D Representation (isometrics, perspectives, photographs)

<b>Discipline</b>	<b>Numbering Sequence</b>	<b>Order of Drawings</b>
<b>(P) Plumbing <sup>1</sup></b>	0001 - 0999	General (Legend, General Notes; Scope of Work and Construction Sequence)
	1000 - 1999	Plans (Demolition & New Construction)
	2000 - 2999	Elevations
	3000 - 3999	Sections
	4000 - 4999	Large Scale Views
	5000 - 5999	Details
	6000 - 6999	Diagrams
	7000 - 7999	Schedules and Lists
	8000 - 8999	User Defined
	9000 - 9999	3D Representation (isometrics, perspectives, photographs)
<b>(D) Process</b>	0001 - 0999	General (Legend, General Notes; Scope of Work and Construction Sequence)
	1000 - 1999	Plans (Demolition & New Construction)
	2000 - 2999	Elevations
	3000 - 3999	Sections
	4000 - 4999	Large Scale Views
	5000 - 5999	Details
	6000 - 6999	Diagrams (Process Flow, Piping & Instrumentation for process systems, gloveboxes and fume hoods)
	7000 - 7999	Schedules, Lists
	8000 - 8999	User Defined
	9000 - 9999	3D Representation (isometrics, perspectives, photographs, risers)
<b>(M) Mechanical <sup>2</sup></b>	0001 - 0999	General (Legend, General Notes; Submittals, Scope of Work Construction Sequence, Schedules)
	1000 - 1999	Plans (Demolition & New Construction)
	2000 - 2999	Elevations
	3000 - 3999	Sections
	4000 - 4999	Large Scale Views
	5000 - 5999	Details
	6000 - 6999	Diagrams (PFDs, P&IDs, Logic)
	7000 - 7999	Schedules, Lists
	8000 - 8999	User Defined
	9000 - 9999	3D Representation (isometrics, perspectives, photographs)

<b>Discipline</b>	<b>Numbering Sequence</b>	<b>Order of Drawings</b>
<b>(E) Electrical</b>	0001 - 0999	General (Legend, General Notes; Scope of Work and Construction Sequence)
	1000 - 1999	Plans (Demolition & New Construction) (floor, equipment, power, lighting, grounding, lightning, emergency, special systems)
	2000 - 2999	Elevations
	3000 - 3999	Sections
	4000 - 4999	Large Scale Views
	5000 - 5999	Details
	6000 - 6999	Diagrams (one-lines, ladder grounding lightning wiring, logic, schematics (control systems i.e.: PLC cabinet), Riser - Fire Alarm Public Address Communication Security.
	7000 - 7999	Schedules (Bill of Material, Nameplate, etc.)
	8000 - 8999	User Defined
	9000 - 9999	3D Representation (isometrics, perspectives, photographs)
<b>(T) Tele-communication</b>	0001 - 0999	General (Legend, General Notes; Scope of Work and Construction Sequence)
	1000 - 1999	Plans
	2000 - 2999	Elevations
	3000 - 3999	Sections
	4000 - 4999	Large Scale Views
	5000 - 5999	Details
	6000 - 6999	Diagrams
	7000 - 7999	Schedules
	8000 - 8999	User Defined
	9000 - 9999	3D Representation (isometrics, perspectives, photographs)
<b>(R) Other Disciplines (i.e., Security &amp; Safeguards)</b>	0001 - 0999	General (Legend, General Notes; Scope of Work and Construction Sequence)
	1000 - 1999	Plans (Demolition & New Construction)
	2000 - 2999	Elevations
	3000 - 3999	Sections
	4000 - 4999	Large Scale Views
	5000 - 5999	Details
	6000 - 6999	Diagrams
	7000 - 7999	Schedules
	8000 - 8999	User Defined
	9000 - 9999	3D Representation (isometrics, perspectives, photographs)

Discipline	Numbering Sequence	Order of Drawings
<b>(O) Operations</b>	0001 - 0999	General (Legend, General Notes; Scope of Work and Construction Sequence [for construction by Support Services Subcontractor only], Schedules/Lists)
	1000 - 1999	Plans (Demolition & New Construction)
	2000 - 2999	Elevations
	3000 - 3999	Sections
	4000 - 4999	Large Scale Views
	5000 - 5999	Details
	6000 - 6999	Diagrams
	7000 - 7999	Schedules
	8000 - 8999	User Defined
	9000 - 9999	3D Representation (isometrics, perspectives, photographs)

<sup>1</sup>. Drainage (gravity/pumped, vent, potable and nonpotable water systems).

<sup>2</sup>. Air conditioning, ventilation, cooling, heating, refrigeration, fuel oil, compressed air, laboratory gas steam and condensate systems.

## 2.0 PRIORITY DRAWINGS

- A. *Guidance: Priority Drawings typically consist of piping and instrument diagrams (P&IDs), flow diagrams, and electrical one-line diagrams helpful to the safe operation and shutdown of a facility. Other types of drawings such as architectural drawings, mechanical prints, floor plans, piping schedules, or databases may be included if facility requirements dictate.*
- B. The importance of the system and its documents (e.g., drawings) shall be determined by the Facility Manager for new and existing facilities in regards to control of nuclear and non-nuclear hazards, the safety of the public, environment, worker (i.e., hazard class, hazard category, etc.), and the facility mission ([LIR240-01-01](#), Configuration Management).
- C. A priority drawing shall have the word "PRIORITY DRAWING" stamped in black or electronically inserted on the sheet, 1/4" text height, layer "PRIORITY," color white, Romand font. The word shall appear just above the title block space allocated for revisions (see Section 202.A, items 1-9). Refer to the LEM [P&ID](#) sample drawings for an example.

## 212 LINE WORK

### 1.0 BASIC LINE WIDTHS

- A. Use a heavy line width to indicate new construction for a given discipline.
- B. Use a medium line width for text and to delineate new construction above or below the drawing plane.
- C. Use a light line width to delineate existing construction or new background base plans, and for dimension lines, leader lines and extension lines.
- D. Contrast the three line widths definitively as illustrated below:

LINE DESCRIPTION	LINE APPEARANCE	LINE TYPE	LINE WIDTH	
CENTER LINE		CENTER	0.25 MM	0.010 INCH
DIMENSION LINE		CONTINUOUS	0.25 MM	0.010 INCH
LEADER LINE		CONTINUOUS	0.25 MM	0.010 INCH
FUTURE CONSTRUCTION		DASHED	0.25 MM	0.010 INCH
EXISTING CONSTRUCTION		PHANTOM	0.25 MM	0.010 INCH
BACKGROUND		CONTINUOUS	0.25 MM	0.010 INCH
HIDDEN LINE		HIDDEN	0.35 MM	0.015 INCH
NEW CONSTRUCTION AND REVISION CLOUD		CONTINUOUS	0.50 MM	0.020 INCH
MATCH LINE		CENTER	0.60 MM	0.025 INCH
EXISTING TO BE REMOVED		PHANTOM	0.25 MM 0.50 MM	0.010 INCH 0.020 INCH LINE ASTERISK
P&ID PROCESS LINES, SECTION CUTS, HIGHLIGHT BOX AROUND TEXT		CONTINUOUS	0.80 MM	0.032 INCH

Figure 212-1

## **213 STANDARDIZATION OF TEXT**







### **1.0 FONT STYLES AND TEXT SIZE REQUIREMENTS**

- A. Use only standard AutoCAD fonts: Romans and Romand. Do not use stylized fonts or fonts not standard to AutoCAD.
- B. Fonts other than Romans and Romand can be used on the title sheet (Section 203) for the Design Agency logos. If a logo contains a font that is not standard to AutoCAD, convert the logo to a drawing or change the logo to an electronic format that can be read by the standard AutoCAD package.
- C. Match the existing font style and height for uniformity of presentation when revising existing drawings.
- D. The minimum text height in the drawing field on C and D size sheets is 1/8 inch.
- E. The minimum text height in the drawing field on A and B size sheets is 3/16 inch.
- F. The minimum text height only applies in circumstances when another convention is not specified in this document.

### **2.0 TEXT FORMATTING CONVENTIONS**

- A. Create all text in upper case letters, with the exception of certain unit designations such as kVA, mm, kHz, Vac, Vdc, mA, which are recognized as an industry standard.
- B. Use text that is readable when reduced to one-half size on half-size drawing sets.
- C. Leave a minimum space of one-half the text height between text lines and special marks to maintain legibility.
- D. Maintain standard text conventions across disciplines in a drawing set.
- E. Orient text to read horizontally from left to right and/or vertically from the bottom to the top of the sheet.
- F. Font width factor shall be a "1" unless otherwise specified in this manual.

G. When inserting text into a D or E size drawing comply with the following:

TEXT FOR	EXAMPLE	LINE WIDTH	FONT
MAIN TITLE	ABCDEFG      RSTU  1/4" WXYZ  1/4"	0.50 MM 0.020 INCH	ROMAND
SUB TITLE	ABCDEFG      RSTU  3/16" WXYZ  3/16"	0.35 MM 0.015 INCH	ROMAND
ALL TITLE BLOCK TEXT	(SEE SECTION 202 FOR CHARACTER SIZE)	0.35 MM 0.015 INCH	SEE SECT. 202 FOR FONT
ALL OTHER TEXT	MINIMUM SIZE TEXT ABCDEFG      VWXYZ  1/8" ABCDEFG      VWXYZ  1/8"	.035 MM 0.015 INCH	ROMANS

**Note:** The "Sub Title" designation referred to in the table above is most commonly used in schedules. The schedule title is the main title (1/4" Romand) and the column headers for the schedule are the sub titles (3/16" Romand).

## 214 SECTIONS, ELEVATIONS, DETAILS, AND CALLOUTS

- A. Identify sections, elevations, and details by referencing them with symbols or callouts.
- B. Font width in detail, elevation, and section bubbles shall be 0.75.

### 1.0 REFERENCE DESIGNATIONS

Identify sections and elevations by **LETTERS**, and details by **NUMBERS**. Reference sections, elevations and details with the discipline sheet number, for example: A1, C1, S1, ...

### 2.0 PROTOCOL FOR REFERENCES AND CALLOUTS

- A. On the sheet where details, sections or elevations are drawn, number or letter them independently by sheet, as opposed to consecutively by discipline or project. Order the numbers and letters sequentially in each drawing sheet that contains elevations, details or sections. Begin with the number 1 for details, and the letter “A” for the elevation or section designation.
- B. When a detail or section is eliminated, the deleted detail or section number or letter may be reused or left blank. The details or sections do not have to be renumbered as the result of a deletion.

### 3.0 EXAMPLES OF PROTOCOLS

- A. A section, detail or elevation drawn on the same with a plan or collectively is not permitted.
- B. A detail, section or elevation **not** drawn on the sheet it is referenced or cut:

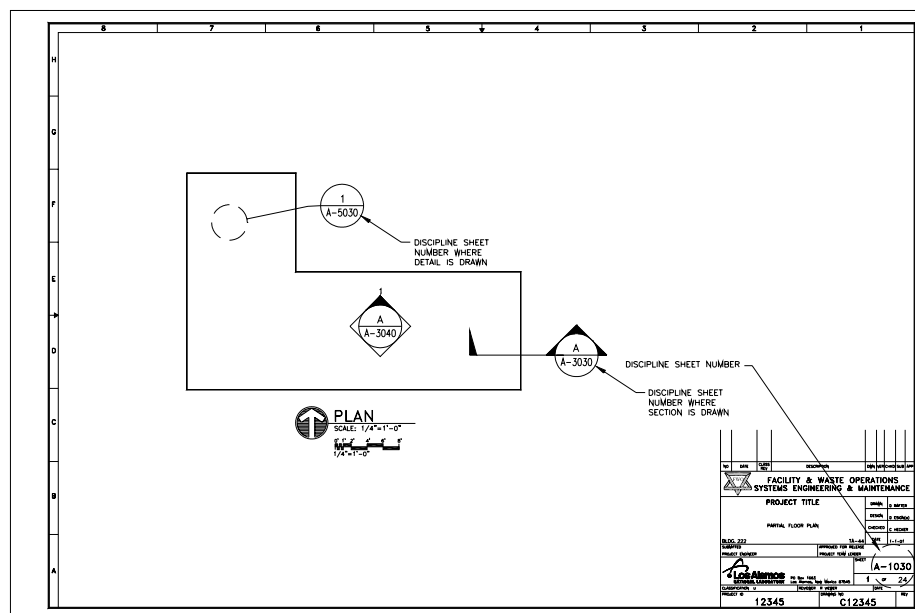


Figure 214-1

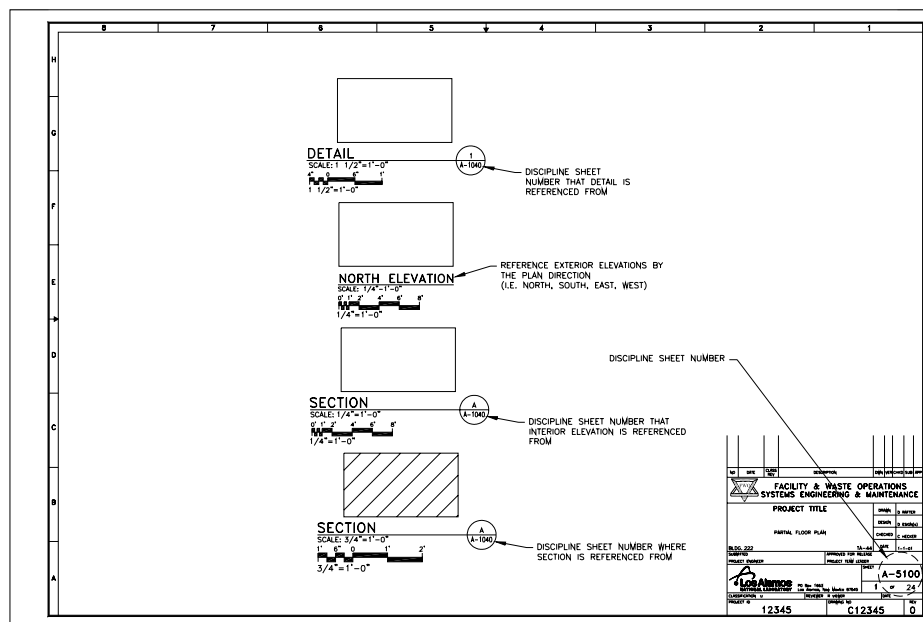


Figure 214-2

## 4.0 SECTION SYMBOLS

### A. Standard Section Symbol:

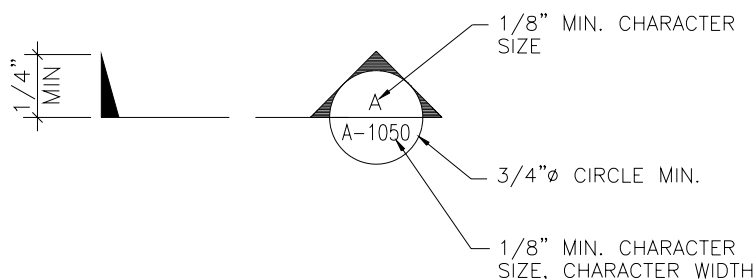


Figure 214-3

### B. Acceptable Section Symbols when space for referencing is severely restricted:

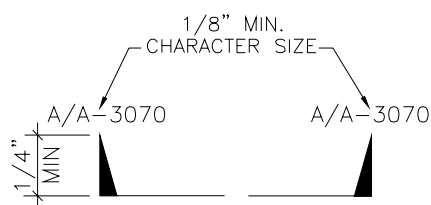
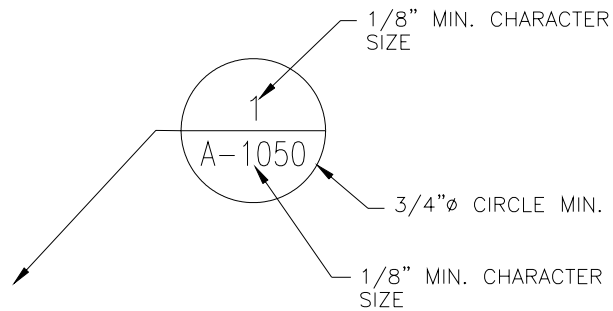


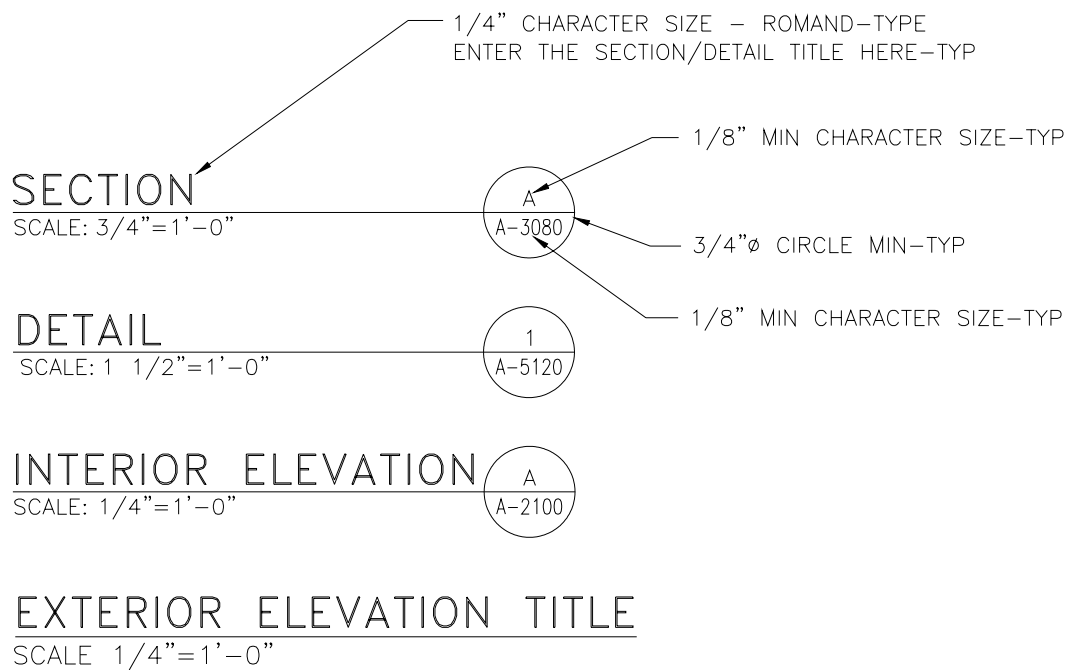
Figure 214-4

C. Detail Symbol



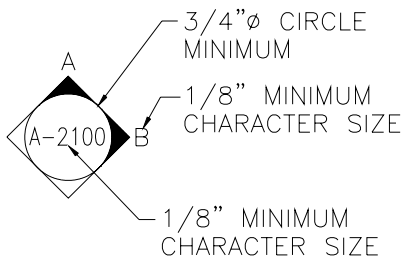
*Figure 214-5*

**5.0 SECTION, ELEVATION, AND DETAIL TITLES**



*Figure 214-6*

## 6.0 INTERIOR ELEVATIONS SYMBOL



*Figure 214-7*

## 7.0 EXTERIOR ELEVATIONS

Reference exterior elevations by the plan direction (i.e., North, South, East, and West).

## 8.0 KEYED NOTES

- A. Use keyed notes where space is limited in the drawing field.
- B. Number keyed notes independently by sheet, as opposed to consecutively by discipline or project.
- C. Begin numbering keyed notes on each sheet that contains keyed notes with the number one. Number each note sequentially in ascending order.
- D. If a keyed note is deleted, insert the comment "not used" in place of the deleted note or re-use the number for another note. It is not necessary to re-number keyed notes because of a deletion.
- E. When a keyed note is used, show the keyed note legend on the same sheet where reference is made. See Figure 202-1 for location of the Keyed Note legend.
- F. Do not use keyed notes for dimensions, air flows (CFMs), or under any other circumstances that are inappropriate.
- G. The keyed note symbol is an oval with a number designation. The standards established for text apply to the numeric character in the keyed note bubble. See Figure 214-8 for an example of the Keyed Note style. General Symbol G-46 and G-47 ([Appendix B](#)) establishes keyed note bubble size and "Keyed Notes" legend header.

- H. The following is the example of the format for the keyed note legend.

### KEYED NOTES

- ① (KEYED NOTE 1 TEXT)
- ② (KEYED NOTE 2 TEXT)
- ③ (KEYED NOTE 3 TEXT)
- ④ (KEYED NOTE 4 TEXT)
- ⑤ (KEYED NOTE 5 TEXT)

*Figure 214-8*

## **9.0 GENERAL NOTES**

- A. When a general note is used, show the general notes on the same sheet where reference is made.
- B. The General Notes legend shall be located below the “keyed note” legend as shown in Figure 202-1.
- C. The General Notes legend header shall be the same as the keyed note header established in General Symbol file number G-46 of [Appendix B](#).
- D. The following is the example of the format for the general note legend:

### GENERAL NOTES

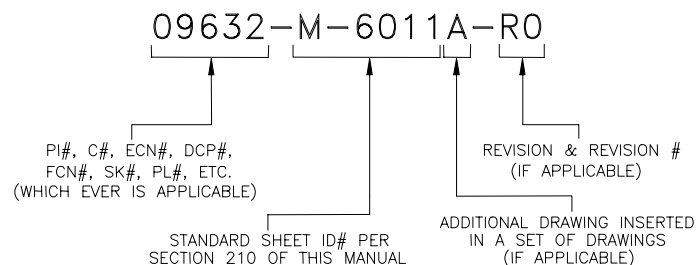
- 1. (GENERAL NOTE 1 TEXT)
- 2. (GENERAL NOTE 1 TEXT)
- 3. (GENERAL NOTE 1 TEXT)
- 4. (GENERAL NOTE 1 TEXT)
- 5. (GENERAL NOTE 1 TEXT)

*Figure 214-9*

## 215 ELECTRONIC CAD FILE CONVENTIONS

### 1.0 ELECTRONIC FILE NAMING CONVENTION

- A. One complete set of electronic files shall be placed on CD(s) and sent to FWO-SEM CM Team (TA-3, Building 410, Room 109) via a transmittal letter itemizing the contents and confirmation that the project has been approved and completely signed off for construction and as-builts.
- B. Affix a stick-on label to the CD with the following completed data:
- LANL Project ID#
  - LANL Drawing # (C#) or ECN#, DCP#, FCN#, SK#, or PL#
  - TA and Building
  - Title of Project
  - Number of electronic files submitted: X of X
- C. Each drawing file on the electronic CD shall contain:
- Project Identification (PI#) or Drawing # followed by the sheet identification number:



- D. CD's that contain classified information shall be identified as such per S-7 and/or ADC instructions.

### 2.0 LINE WIDTH ASSIGNMENT IN ELECTRONIC FILES

Assign lines a width by creating the line or entity in an appropriate layer. Each layer is assigned a color for the desired line width of entities created in that layer. As indicated in the table below, colors 1 through 15 are the extent of the allowable color range for LANL projects.

Color Number	Line Width in mm	Line Width in Inches
1	0.50	0.020
2	0.50	0.020
3	0.50	0.020
4	0.50	0.020

Color Number	Line Width in mm	Line Width in Inches
5	0.35	0.015
6	0.35	0.015
7	0.35	0.015
8	0.35	0.015
9	0.025	0.010
10	0.025	0.010
11	0.025	0.010
12	0.025	0.010
13	0.070	0.030
14	0.070	0.030
15	0.050	0.020

### **3.0 CAD LAYERING GUIDELINES**

#### **3.1 Maximum Number of Layers**

Fifty (50) is the preferred maximum for the number of layers in a drawing file. In extreme cases, it is acceptable to increase the number of layers to a maximum of 100.

#### **3.2 Layer Naming Convention**

Use the US National CAD Standard Version 2 (or later) AIA CAD Layer Guidelines “short format” layer names for establishing layer names for all drawings. The only exceptions to those guidelines are:

1. The addition of a “G” (for general) group in the major groups. The “G” major group is added for general information that is not discipline specific, such as Title Blocks, Title Sheets, Submittal, and General Notes sheets and Symbols that are applicable to all disciplines.
2. Do not exceed 16 characters in assigning any layer name. This allows for the addition of extra characters that are added to the layer name automatically when X-Refs are used and eventually bound to the file.

### **4.0 ELECTRONIC FILE FORMAT FOR FINAL DELIVERABLES**

- A. If another graphics software was used to create a drawing file, deliver the file in a format that can be recognized by and converted to AutoCAD (i.e.: ASCII format, DXF file).
- B. It is preferred that only standard AutoCAD Release 14 or 2000 options be used in creating drawing files, but third party software that is completely compatible and supportable by AutoCAD Release 14 or 2000 is acceptable.
- C. Not all contractors and subcontractors have AutoCAD release 2000. All electronic files created in AutoCAD 2000 shall be saved as AutoCAD 14.

- D. The deliverable media for electronic files are CD disks. The entire project file can be stored on one CD, provided it fits. Label the disk with the official **PROJECT NAME, LANL PROJECT ID, DRAWING NO.(s), STAGE/PHASE** (Title II, Engineering Study, etc), **DATE SUBMITTED, ACAD VERSION/WORD PROCESSING PROGRAM** used to create the documents, **DESCRIPTION OF DOCUMENTS** contained on the disk. It should also be noted if any third party add on software packages were used to augment the standard AutoCAD package.
- E. A "read me" file is required if special instructions are needed for other users to understand the drawing files.
- F. Bind all externally referenced (X-REF) drawing files using the X-REF Bind command sequence. Refer to the AutoCAD Users Guide for instructions on binding x-refs.
- G. Identify the plotting scale on the drawing file as well as on the delivered media.
- H. It is not necessary to identify the plotting scale if it is 1:1.
- I. The preferred plotting scale is 1:1. If the scale is different than 1:1, then indicate the scale on the drawing file and the deliverable label.
  - To minimize potting discrepancies for color; dithering; gray scale; pen assignments; screening; line-type; line weight; end styles; join styles; and fill styles, set the AutoCAD plot style to selection "2000-STD-Pens." Refer to the AutoCAD Users Guide, "Plotting Your Drawing" for assistance in setting this plotting style.
  - Shading (if required) in a drawing shall be done by using the standard AutoCAD Hatch Patterns.
- J. Final deliverables shall be "As-Built" documents with the conversion requirements implemented from Section 103, "As-Built Revision Procedures" of this manual.
- K. "Purge" all unnecessary blocks, text styles, and layers on all drawings prior to electronic FWO-SEM submittals. Refer to the AutoCAD Users Guide for the "purging" procedure.

## 216 FOLDING DRAWING PRINTS

### 1.0 PRINT FOLDS

A. *Guidance: Drawing sizes "B" through "E" and roll sizes are normally folded after printing to 8 1/2 x 11 inches to fit standard-size file folders and filing cabinets. See Figure 216-1*

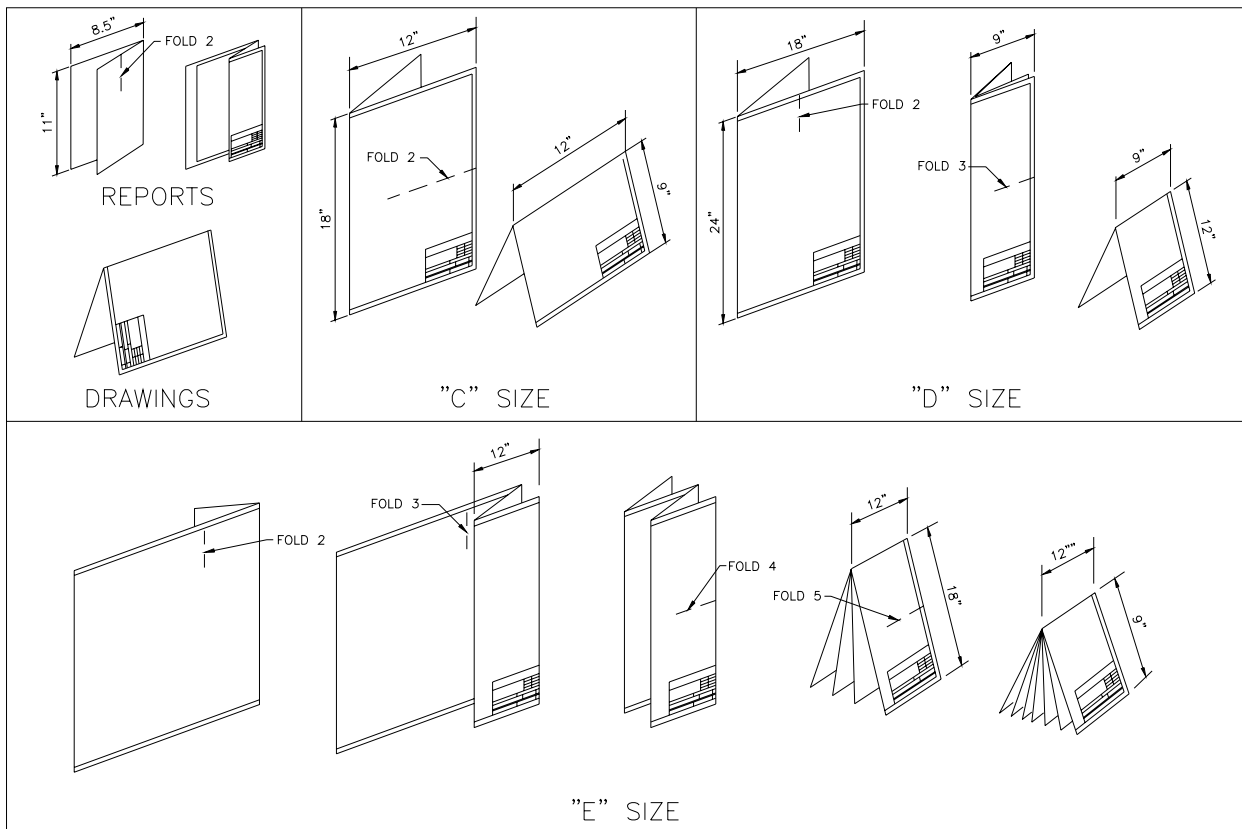


Figure 216-1

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**RECORDS OF REVISION**

<b><u>Rev.</u></b>	<b><u>Date</u></b>	<b><u>Description</u></b>	<b><u>POC</u></b>	<b><u>OIC</u></b>
0	06/29/99	Document rewritten and reformatted to support LIR 220-03-01. This chapter supersedes LANL Facility Engineering Standards Drafting Manual, Vol. 2, Rev. 7, dated 4/17/98.	Danny Nguyen, <i>PM-2</i>	Dennis McLain, <i>FWO-FE</i>
1	10/29/01	Symbols - generated & on-line; Civil – expanded; Structural – slight modification; Architectural, Mechanical, Electrical - expanded greatly; Mechanical and Electrical - also refer to LEM new examples.	Richard Trout, <i>FWO-SEM</i>	Mitch S. Harris, <i>FWO-SEM</i>

## **301 SYMBOLS**

### **1.0 WHERE TO USE SYMBOLS**

*Guidance: Standard symbols should be used on all drawings, whenever possible. The use of symbols can reduce the drawing time and clarify the drawings by the elimination of unnecessary details.*

### **2.0 SIZE OF SYMBOLS**

*Guidance: Symbol sizes can vary according to their use on drawings made “to scale” or “not to scale.” The size of symbols on drawings “not to scale” is dependent upon the complexity and aesthetics of the drawings.*

### **3.0 SYMBOL TYPES**

*Guidance: The LANL Drafting Manual library graphic symbols found in the Table of Contents are not intended to be a complete listing of all possible symbols required for a project. Symbols may be created if not available in the Drafting Manual graphic symbol library or in industry standard symbols.*

Symbols generated that are not in the LANL Drafting Manual library shall be identified on the discipline legend with a (NS) “non standard” located to the right of the symbol description.

## **302 CIVIL DRAWINGS**

### **1.0 DRAWING DESIGN PREPARATION**

- A. The drawings are to be drawn to scale and north arrow symbol shown. Dimensions are to be shown in feet and decimals of a foot. Elevations are to be shown in feet and decimals of a foot.
- B. Include in the site plan existing features such as: buildings, roads, walks, parking areas, large trees, underground and overhead utilities, valve boxes, water meters, fire hydrants, pressure reducing valves, backflow preventers, thrust blocks, valve pits, and other features pertinent to the specific project.
- C. Refer to the mechanical drawings for lift stations, sumps, valves, etc. Include in the civil drawings site utilities outside building perimeters. Electrical/communications site plans may be separated from the utilities plans providing they are carefully coordinated.
- D. Prepare the site plan from a current survey tied to known survey markers located in accordance with the New Mexico State Plan Coordinate System (NMSPC), central zone, and mean sea level elevations. The scale is 1 inch equals 20 feet. Include in the plan information necessary for layout of all elements of the new project.
- E. Include in the plans, or separated drawing, existing and new features including final contours at appropriate intervals; spot elevations; finish grades for drainage; site improvements; plan and profile of roads, walks, and drainage structures; test hole boring locations; and log data (if available).
- F. Include in the landscape and/or terrain management plan a plan of arrangement; list of a plant material; fences; signs; erosion control; irrigation systems; berms; furniture; screens; gravel areas; lights; and other landscape features and structures.
- G. Show if a plan and profile drawing sheet are prepared for a utility plan for existing and new utility systems in the area surrounding the project at a scale of 1 inch equals 20 feet. Prepare a plan and profile for new underground utility systems showing invert elevations and cover over the systems shown. Adjustments to the scale may be allowed to avoid excessive sheets and match lines.
- H. Prepare design profiles for: sanitary sewers, storm drains, steam and condensate lines, roadways, and other facilities as required.
- I. Prepare profiles or cross-sections for locations where new underground utility runs cross other existing utilities. Show new utility lines as continuous in profile with break lines provided to show changes in direction. Stationing for gravity sewers, storm drains and drainage channels shall progress down gradient. Progress stationing from left to right on the drawing.
- J. Reproduce the soil boring logs and required notes on the drawings per Standard Engineering practice.

**2.0 GRADING AND SITE PLANS**

Include the following:

- A. Existing structural/utilities include structural number, type, size, and locations from survey information.
- B. Manhole invert and rim elevations for existing sewers, storm drains, electrical manholes, etc.
- C. New construction, items to be removed, and limits of work.
- D. Clearing and grubbing areas.
- E. Grading and paving existing contours, finished contours and spot elevations.
- F. Stationing, NMSPC coordinates or bearings and distances for location of facilities.
- G. Boring test holes and logs where applicable.
- H. Cross sections where major grading work is involved.
- I. Erosion control measures and type Storm Water Pollution Prevention Plan (SWPP).
- J. Match lines of adjacent drawings.
- K. Fencing (standard or security).
- L. Pedestrian/vehicle circulation patterns, parking layout, striping.
- M. Location map.
- N. Traffic control/signals/signs.
- O. Stockpile and borrow areas
- P. Temporary laydown areas for the contractor's equipment
- Q. Security fence locations for "Bubbled Out" (space left blank for security purposes) areas.

**3.0 LANDSCAPING PLANS**

Include the following:

- A. Planting/irrigation.
- B. Recreational layouts.
- C. Visual screening.
- D. Plant species and size.

**4.0 UTILITY PLOT PLANS**

Include the following:

- A. Location of facilities (no contours required).
- B. Location of all utilities and describe them as to size, type material and indicate fittings.
- C. Proposed points of intersections of all utilities crossings for interference.
- D. Depth of cover for utilities.
- E. Details.

**5.0 ROAD PLANS**

Include the following:

- A. Geometric plan and profile, pavement markings, thickness, cross section, and traffic control devices.
- B. Operational plan for vehicular circulation is required showing turnaround movements, ingress and egress.
- C. Center line location, coordinates, or bearing and distances.
- D. Stationing.
- E. Curve data (show delta (D), radius (R), tangent (T), length (L), point of curvature (PC), point of intersections (PI), and point of tangency (PT).
- F. PC and PT stationing.
- G. PI coordinates.
- H. Typical section.
- I. Culverts, ditches, and hillside interceptor benches and slopes.
- J. Utility crossings.
- K. Parameters of horizontal alignment.

**6.0 ROAD PROFILES**

Include the following:

- A. Ground line (existing grade at centerline road).

- B. Finished grade (top of finished surface at centerline).
- C. Left and right curb profiles (if required).
- D. Grades in percentages.
- E. Elevations at stations and vertical curve: vertical point of curvature (VPC), vertical point of intersection (VPI), and vertical point of tangency (VPT).
- F. Elevations along vertical curve (if required).
- G. Parameters of vertical alignment.
- H. Culverts & utilities crossing roads.

## **7.0 ROAD CROSS SECTIONS (LOOKING DOWNSTATION)**

Include the following:

- A. Station, location, and scales.
- B. Centerline location.
- C. Existing ground line (phantom line type).
- D. Finished roadway surface and bottom of base course.
- E. Show cut and fill lines and slopes.

## **8.0 STORM DRAIN PLANS**

Include the following:

- A. Sub-structures size and location. (To be relocated or removed.)
- B. Existing storm drains.
- C. Existing sewers.
- D. New storm drain location (Street or Coordinates and Bearings), stationing, curve data (show D, R, T, L, PC, PI and PT), manholes and transition structures, and junction structure.
- E. Catch basin location. (Tie to curb returns or centerline road), type, size, top of invert).
- F. Pipe length, size, type, and end inverts.
- G. Utilities crossings - water, sewer, gas, oil.
- H. Trench conditions.

**9.0 STORM DRAIN (PROFILE)**

Include the following:

- A. Ground line (existing grade over storm drain).
- B. Street names and stations.
- C. Sub-structures (utilities) including crossings sizes, interferences, and elevations.
- D. Stationing of beginning and end of sheet (match lines), manholes, structures, and grade changes.
- E. Storm drain slope (ft/ft), top and bottom elevations (ft), length and D-load of pipe or strength, box size, station, size, and direction of connecting pipe inlets, and transition structures.
- F. Parallel existing storm drains.
- G. Parallel existing sewers.
- H. Blankets and encasement for sewers.
- I. Details of crossings with existing utilities.

**10.0 SANITARY SEWER PLANS**

Include the following:

- A. Substructures (existing utilities), size, and location.
- B. New sewer location (street or coordinates and bearings), stationing, curve data (show D, R, T, L, PL, PI and PT), manholes (type and all callouts from standard drawings), and sizes.
- C. Encasement of sewer.
- D. Curbs, driveways, and sidewalks to be removed and replaced.
- E. Fire hydrants, valves, or meters to be relocated.

**11.0 SANITARY SEWER PROFILES**

Include the following:

- A. Existing ground line and proposed grade over centerline of sewer.
- B. Substructures (utilities) crossing size, type, top and bottom elevations - (excavated and checked, if required).
- C. Stationing of beginning and end of sheet (match lines), manholes, structures, and grade changes.

- D. Sewer profile slope and elevations, (ft/ft) and (ft), length and type of pipe, station size and direction of connecting inlets or Y branches.
- E. Parallel existing sewers.
- F. Parallel existing storm drains.
- G. Encasement for sewers.
- H. Details of crossings with existing utilities.

## **12.0 WATER SUPPLY AND DISTRIBUTION**

Include the following:

- A. Location of all structures and facilities.
- B. Location, size and type of domestic water lines, valves, valve pits, meters, etc.
- C. Location, size and type of fire water lines, hydrants, post indicator valves, PRV's, sectional (gate) valves, valve boxes, meters, and pits.
- D. Coordinates at all angle points of distribution lines.
- E. Bearing and distance between PI's.
- F. Show utilities and structures along alignment.
- G. Show invert elevations at all crossings - both utilities.
- H. Calculations for alignment.
- I. Typical trench sections and bedding.
- J. Thrust blocks location and calculations.
- K. Curve data, if required, D, R, T, L, PL, PI and PT.
- L. Plan and profile if required; use applicable portions of sewers.

## **13.0 RADIOACTIVE LIQUID WASTE, CAUSTIC, ACID AND CHEMICAL PLANS, AND PROFILES**

Include the following:

- A. Existing ground line and proposed grade over the piping.
- B. Substructures (utilities) crossing size, type, top and bottom elevations (excavated and checked, if required).

- C. Stationing of beginning and end of sheet (match lines), manholes, structures, monitoring stations and grade changes.
- D. Piping profile slope and elevations, (ft/ft) and (ft), length and type of pipe, size, station size, and direction of connecting inlets or Y branches.
- E. Monitoring system instrument and control
- F. Location of control valves, type, model number, and access requirements.

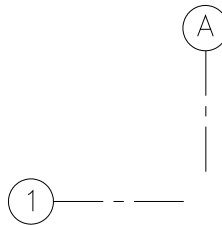
## **14.0 CIVIL SYMBOLS**

See [Appendix C](#) of the LANL Drafting Manual.

### **303 STRUCTURAL DRAWINGS**

#### **1.0 DESIGNATION OF COLUMN LINES**

- A. Show column lines using 0.35 mm (0.015 inches) pen width, pen color 7 (white) to form center lines and 1/2 inch circles on layer name S-GRID. All other disciplines shall use this convention for column lines.



*Figure 303-1*

- B. Column line designations for new jobs shall be:

- Horizontally by letter starting with A to the left.
- Vertically by number starting with 1 at the top.

For existing conditions match existing column designations.

- C. Designate minor columns and posts by adding a suffix to the number or letter of the next major column to the left or above as the case may be. Obtain this suffix by proportioning the distance from the major column to the post to the whole bay width, i.e., 2.4, 2.8, B.d, C.h. Use lower-case letters for the letter suffixes.
- D. On the Plot Plan and Foundation Drawings, locate structures by coordinates. The location of the coordinates shall be the intersection of the column lines in the northeast corner of the structure, where practical.

## 2.0 STRUCTURAL STEEL FRAMING DRAWINGS

Framing Plans and Framing Elevations are schematic drawings. Show the centerlines of steel framing members as solid heavy lines stopping short of the member they frame into. Only show partial outlines of webs, flanges, and legs of members when necessary for clarity.

Example:

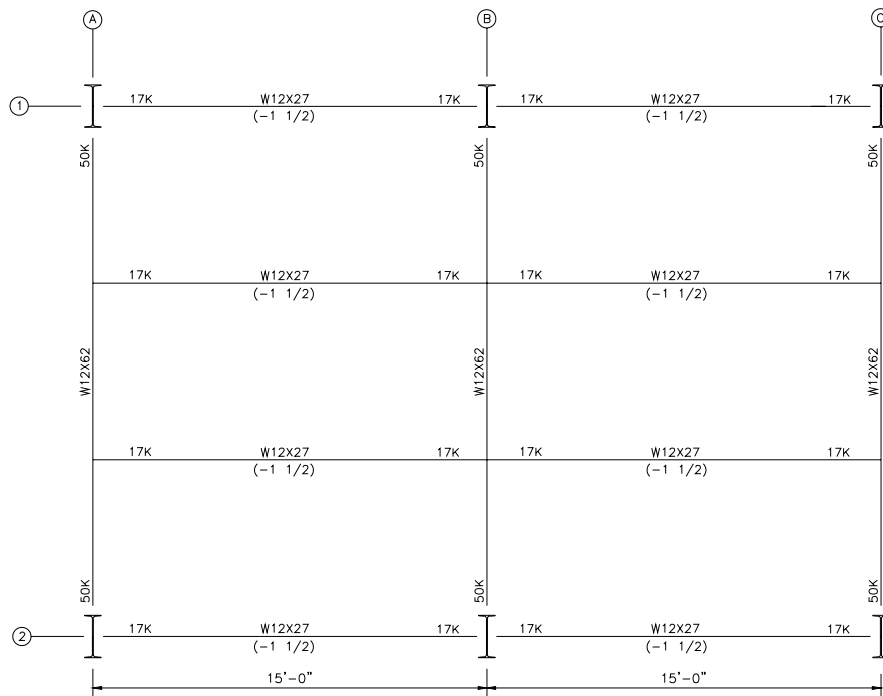


Figure 303-2

## 3.0 STRUCTURAL STEEL SHAPES

Label structural steel construction, per AISC M013, "Detailing for Steel Construction."

## 4.0 REINFORCED CONCRETE

Symbols commonly used on reinforced concrete drawings are:

- # To indicate size of deformed bar (superscript)
- Ø Plain rounds, e.g., spirals (superscript)
- @ Spacing center to center
- ↗ Direction in which bars extend
- ↔ Limits of area covered by bars

**5.0 STRUCTURAL DRAWINGS****5.1 Dimensioning**

On plan views, dimensions are to be tied into points which can readily be transferred to concrete, steel, and other drawings including plot plans. Clearly indicate match lines and centerlines of columns and equipment. When possible, keep dimensions outside the equipment and details. Dimension drawings in feet and inches.

**5.2 Elevations**

- A. Indicate elevations on Foundation Drawings in decimals of a foot, e.g., EL 96.25. Indicate elevations on Superstructure Concrete and Steel Drawings in feet and inches, e.g., EL 115' - 6-1/2"
- B. Indicate floor and platform elevations to top of steel. Reference floor plate, top of grating or top of slab as + or - elevation to top of steel.
- C. Generally, the high point of the ground floor slab is to be the main vertical reference line.

**5.3 Co-ordinates**

On the Plot Plan and Foundation Drawing, locate structures by 2 sets of coordinates. The location of the coordinates shall be the intersection of the column lines and/or at corners of the structure, where practical.

**5.4 Loads and Reactions**

- A. Indicate the design loads for principal equipment supported on the drawings in their respective locations.
- B. Note Foundation Drawings with "Max Foundation Pressure = \_\_\_\_\_ lbs/sq. ft." Piling Drawings shall be noted with "Max Pile Load = \_\_\_\_\_ lbs/pile."
- C. Show floor and roof live loadings as well as wind and seismic design basis for future reference and for floor loading postings.

**6.0 REINFORCED CONCRETE DRAWINGS****6.1 General**

In general, the drafting procedures shown in the ACI 315, "Details and Detailing of Concrete Reinforcement," published by the American Concrete Institute are acceptable.

**6.2 Reinforcing**

- A. Space reinforcing bars to the nearest inch, preferably, but in no case shall they be spaced closer than the nearest quarter-inch. Call-out of bars should be in one view where practical.
- B. Note bar spacing in inches, and inch marks are not to be used, e.g., #6 @ 18.

- C. Note bending details on the "Bending Schedule for Reinforcing Steel" where job requirements call for detailing the reinforcing. Show and identify bars cut in a section.

## **7.0 STRUCTURAL STEEL DRAWINGS**

### **7.1 General**

The drawings prepared by the designer shall convey the information necessary for the preparation of erection and shop drawings by the steel fabricator.

They shall indicate the type of construction, types of beams and columns, and shall provide all necessary data on loads, shears, moments, and axial forces to be resisted by all members and their connections.

### **7.2 Connections**

- A. Projects are to be shop welded and field bolted where possible.
- B. Holes for field connections are to be 1/16" larger in diameter than bolt. Holes in structural steel to match equipment hole locations shall be made 3/16" larger in diameter than connecting bolts. Holes for anchor bolts in column base plates shall be 5/16" larger in diameter than the bolt for 3/4" and 7/8" bolts and 1/2" larger for bolts 1" and over.

### **7.3 Welding**

- A. Welding details and notes shall be made clear and complete. The size, type, length, and spacing must be given. Standard symbols and notations shall be in accordance with American Welding Society's specifications.
- B. A note of caution is given here with respect to welding to vessels which may be stress relieved before shipment to field. No field-welded connections will be allowed, and any connections which are to be made to such vessels must be done by the vessel fabricator.

## **304 ARCHITECTURAL DRAWINGS**

### **1.0 DRAWING DESIGN PREPARATION**

- A. All building “plan” drawings are to be drawn at a minimum of  $1/8" = 1' - 0"$  scale preferably at  $1/4" = 1' - 0"$  scale oriented as previously noted in this manual with a north arrow shown.
- B. All drawing dimensions are to be noted in feet and inches.
- C. All building elevations are to be drawn in the same scale as the building plan drawings.
- D. Main floor is to be noted as 100' - 0" elevation on plan.
- E. All plans shall be in accordance with all approved applicable codes, NFPA and Factory Mutual.
- F. Where plans involve the addition to or modification of an existing structure the existing structure plans shall be “As-Built” with corresponding building information included.

### **2.0 FOUNDATION PLANS**

Include the following:

- A. The foundation/building perimeter profile.
- B. Column lines.
- C. Location and profile of all slab/finish floor elevation changes.
- D. Hidden line indicating inside and outside of footing (as applicable).
- E. Hidden line indicating the thickness of monolithic slab turndowns (as applicable).
- F. Location of all piping sleeves.
- G. Building section cut symbols.
- H. Detail or detail section symbols.
- I. Plumbing fixturing.
- J. Locations of all inserts duct trays, recessed electrical receptacles or other specialty items to be inserted into floor concrete.
- K. Dimensions.
- L. Exterior foundation perimeter.
- M. Locations of all offsets.

- N. Locations of all slab/floor depressions.
- O. Expansion joints.
- P. Locations of all piping sleeves.

### **3.0 FLOOR PLANS**

Include the following:

- A. Perimeter walls drawn to scale (thickness).
- B. Column lines.
- C. Interior walls drawn to scale (thickness).
- D. Plumbing fixturing.
- E. Fixed in place partition walls (i.e., restroom partitions).
- F. Locations of windows (width) drawn to scale.
- G. Locations of doors with handing, size (width) and type of movement drawn to scale.
- H. Building section cut symbols.
- I. Detail section cut symbols.
- J. Enlarged plan or elevation identification symbol.
- K. Wall, interior elevation, detail symbols.
- L. Room numbers and names.
- M. Cabinetry locations, length and width drawn to scale.
- N. Mechanical, electrical, plumbing and fire protection equipment locations and rooms shown.
- O. Detail, elevation and section symbols shown drawn as per the requirements of this manual.
- P. Areas of enlarged plan shall be circled and referenced.
- Q. Room names and numbers.
- R. Finished floor elevation.
- S. Finished ceiling elevations.
- T. Dimensions.
- U. Overall building with building additions to include existing building.

- V. Building offsets.
- W. Building openings to include doors, windows and insert locations.
- X. Exterior building columns.
- Y. Interior walls.
- Z. Interior fixtures not dimensioned elsewhere.
- AA. Sleeves in cast-in-place concrete walls.
- BB. Centerlines of plumbing fixture locations.

#### **4.0 BUILDING ELEVATIONS**

Include the following:

- A. Approximate final grade line.
- B. Foundation extents identified by hidden line below grade line.
- C. All attributes of building elevations drawn to scale with window and doors having swings identified.
- D. Building section cut symbols.
- E. Detail section cut symbols.
- F. Enlarged plan or elevation area symbols.
- G. Each floor elevation and roof bearing elevation shall be identified as well as any changes within a floor line with a 0.050 broken line.
- H. All associated architectural features shall be shown that are relevant to the structure, i.e., finish changes, architectural finish features like inset stucco bands or tile, parapet coping exterior stairs (below grade shown as hidden lines) or free standing entry canopies.
- I. Expansion joints both building and finish. Stucco expansion joints shall be in conformance with the stucco manufacturer requirements.
- J. Building elevation dimensions.
- K. Floor to floor elevations.
- L. Floor to roof bearing-primary or lowest point.
- M. Overall finished first floor to top of roof or roof parapet or mechanical parapet.
- N. Grade to first floor.

- O. First floor to bottom of lower level (as applicable).
- P. Grade to bottom of footing or turndown.
- Q. Independent features-length and width-marked for general notes by numerical symbol.
- R. Overall length.
- S. Any special features, i.e., overhangs and insets.
- T. Notations.
- U. Materials and types.
- V. Special identifications.
- W. Finish grades, floors, and roof bearing.
- X. Elevation by “called” direction.

## **5.0 BUILDING SECTIONS**

Include the following:

- A. Drawn to scale minimum of  $1/4'' = 1' 0''$  preferably  $3/8'' = 1' 0''$
- B. All sectioned architectural building systems and large components shown.
- C. All background architectural elevation features shown (interior elements).
- D. Primary systems materials section symbols shown.
- E. Dimensions.
- F. Foundation to floor.
- G. Floor to floor.
- H. Floor system thickness.
- I. Primary bearing heights.
- J. Elements not dimensioned elsewhere.
- K. Notations & Symbols.
- L. System or component call-outs.
- M. Circled and referenced to enlarged detail.
- N. Elements not identified elsewhere.

**6.0 ENLARGED DETAILS AND PLANS**

Include the following:

- A. All enlarged details are to be in conformance with previously noted formatting.
- B. All materials or components sectioned are to show materials symbology.
- C. All components shown are to be sized and located to scale.
- D. All background components or features are to be shown.
- E. All materials and components are to be noted and, where applicable, notations shall include height above grade as in plan view.

**7.0 ARCHITECTURAL SYMBOLS**

- A. Symbols used in the AIA Architectural Graphic Standard (AGS) are of such a larger number it would be impractical for LANL to create an architectural symbol library and place them on-line. Therefore, the LANL Symbol Library located on the World Wide Web does not address architectural symbols.
- B. The current edition of the AGS manual shall be used for:
  - 1. Materials in Large scale section and Graphic representation.
  - 2. Materials in Small scale Plan Views and Graphic representation.
  - 3. Surfaces at Small scale and Graphic representation.
  - 4. Surfaces at Large scale and Graphic representation.

## **305 MECHANICAL DRAWINGS**

### **1.0 MECHANICAL DRAWINGS**

Mechanical Drawings are to include plans, elevations, sections, details, and equipment schedules/lists to clearly define the mechanical requirements of the project.

- A. For symbols used in Plans, Sections, Elevations, Details, and Isometrics, use the standard mechanical symbols found in the [LANL Symbol Library](#) in Appendices E1 to E3.
- B. Use double-line piping in highly congested areas as necessary to clarify the construction.
- C. Use double-line ductwork, except where not permitted by Project Engineer. Show diffusers, grilles, and registers with sizes, flow rates and directions of flow noted on the drawings or in a schedule. Indicate all thermostats/sensors, duct mounted controls, control panels, etc., on the ductwork drawings.
- D. Fire protection piping drawings shall be on separate sheets and not included with other piping system drawings, except as may be specifically permitted by Project Engineer.
- E. Include control diagrams and sequence of operations in the mechanical drawing set, if requested by the client.
- F. Individual large scale mechanical equipment room plan and sections as well as mechanical details shall fully detail the design.
- G. Draw mechanical equipment to scale with required maintenance and tube removal spaces outlined. Ensure that the equipment can be installed and/or removed without having to dismantle or remove other equipment or permanent construction.
- H. Indicate the outline of electrical equipment, including working space clearance, on the mechanical drawings (equipment room, plans, etc.) to ensure that the mechanical equipment does not interfere with the electrical equipment working space as required by the NEC. Do not locate mechanical equipment/piping (i.e., water piping, ductwork, pumps, etc.) above switchboards, panel boards, and motor control centers. Consult with the electrical section designer for the applicable code clearance requirements.
- I. Isometrics (riser diagrams) (as a minimum requirement) shall be prepared for the following systems:
  - Potable/non-potable water
  - Sanitary waste/vent
  - Radioactive liquid waste/vent
  - Process liquid waste

**2.0 PROCESS FLOW DIAGRAMS (PFDs) & PIPING & INSTRUMENT DIAGRAMS (P&IDs)**

- A. For engineering requirements pertaining to P&ID diagrams, refer to the [LANL Engineering Manual](#), Chapter 6, Section 310.
- B. Refer to the Process PFD Diagram/P&ID Drafting Symbol Library, Appendix G1-G3, for drafting symbols to be used in Flow Diagrams, P&ID and I&C drawings.
- C. Process Flow Diagrams and P&IDs (at a minimum) shall indicate the items as defined in the LANL Engineering Manual, Chapter 6, Section 310. All text to be 1/8" high, color white (7), 0.35 mm (0.015") thick.
- D. P&IDs may extend beyond the drafting field (refer to LANL Drafting Manual requirements Section 202 Drawing Title Blocks, 3.0.g) for clarity purposes only.
- E. Do not cross control runs. Break secondary signals, not the process line.
- F. Flow Arrows are to be 1/8 inch.
- G. Process Flow Diagram and P&ID Layering Convention modified for LANL use from UDS:

LAYER NAME	DESCRIPTION	COLOR	LINE WIDTH
MI-PC	Main and/or Primary instrument supply or process	13-14	0.70 mm (0.030")
MI-SE	Secondary Systems = Bypasses	1-4	0.50 mm (0.02")
MI-SY	Symbol inserted from the symbol or created on the sheet, plan breaks, continuation flags	7	0.35 mm (0.015")
MI-TX	Text typed or inserted	7	0.35 mm (0.015")
MI-PS	Pneumatic signals	5-8	0.35 mm (0.015")
MI-ES	Electric, electromagnetic, sonic signals	5-8	0.35 mm (0.015")
MI-HS	Hydraulic signals	5-8	0.35 mm (0.015")
MI-US	Undefined signals	5-8	0.35 mm (0.015")
MI-HT	Heat trace	5-8	0.35 mm (0.015")
MI-SL	Software or data link, internal system links	5-8	0.35 mm (0.015")
MI-EL	Mechanical links	5-8	0.35 mm (0.015")
MI-CT	Capillary tube	5-8	0.35 mm (0.015")
MI-WB	Wall barrier	5-8	0.35 mm (0.015")
MI-EX	Existing equipment, systems, components, lines, text, symbols, etc.	9	0.25 mm (0.010")
MI-BL	Buried lines	9	0.25 mm (0.010")

- H. The system flow should generally be from left to right and from top to bottom.
- I. PFD & P&IDs shall be drawn to a scale of 1:1 but labeled as “scale: none” on the drawing.
- J. PFD & P&IDs shall have a snap of 1/16 inch.
- K. For systems having various parameters of operation it is recommended on PFDs that a “Parameter Chart” be shown. The chart should appear on the bottom of the drawing designated for Keyed Notes and General Notes. Layer Text to be 1/8 inch in height, chart outline and vertical columns to be 0.50 mm, 0.025 mm for horizontal lines. Example of a parameter chart as follows:

*Condition #1 = maximum allowable working condition; Condition #2 = normal operating condition; Condition #3 = minimal allowable working condition.*

OPERATING CONDITION		KEY COMPONENTS			
		1	2	3	4
CONDITION #1	FLOW	20,000 CFM			
	PRESS	3.5" H <sub>2</sub> O			
	TEMP	100°F			
CONDITION #2	FLOW				
	PRESS				
	TEMP				
CONDITION #3	FLOW				
	PRESS				
	TEMP				

*Figure 305.1*

- L. Use table form, using parameters at identified locations on process lines as “Keyed Notes.”
- M. PFDs may also warrant a mass flow/balance table.
- N. For symbols required for a PFD and/or P&ID not found in the General Instrument or Function Symbols legend, refer to ISA 5.1. If a symbol is created for a specific project not found in ISA 5.1, create the symbol, add the symbol to the Symbol Legend, and identify the symbol(s) as “non-standard” (NS).

### 3.0 MECHANICAL EQUIPMENT LIST

- A. Example:

MECHANICAL EQUIPMENT LIST				
ITEM NO.	LOCATION RM.NO.	NO. REQ'D.	DESCRIPTION, MANUFACTURER OR APPROVED EQUAL	FURN. BY
1	RM 100	1	PUMP .....	CONTR

*Figure 305-2*

- B. Provide a mechanical equipment list for projects required by client.
- C. Provide an equipment list for each individual discipline set (HVAC, plumbing, fire protection, etc.) and locate the sheet in the discipline drawing set as outlined in Section 211 of this manual.
- D. Indicate mechanical equipment items by an item number in a diamond. The item numbers shall be in sequence for the entire mechanical drawing set. (See Appendix)
- E. Note in the "FURN. BY" column if the equipment is furnished by the contractor (CONTR) or Government Furnished Equipment (GFE).

#### **4.0 MECHANICAL SYMBOLS**

- A. Use applicable graphics symbols on drawings and include a mechanical legend on the first sheet of the mechanical drawing set. Refer to Appendix D and E.
- B. Pipe fitting symbols are depicted without a joint connection symbols. The joint symbol is optional, however, the symbols should be consistent throughout the entire mechanical drawing set. It is also preferred to note the type of joint (welded, soldered, flanged, etc.) in the specification and not by use of a symbol.

**306 ELECTRICAL DRAWINGS**

- A. Refer to [LANL Engineering Manual](#), Chapter 7, Section 5000 (future), for discussion of development and a typical one-line diagram.
- B. Use [ST7001](#), Legend and General Notes, as the starting point for the electrical drawing set legend.
- C. Do not use General Notes on projects that include construction specifications.

**1.0 ONE-LINE DIAGRAMS**

- A. Use symbols and blocks from the LANL Electrical Symbol Library, Appendix F of this manual.
- B. All text to be 1/8" high, color white (7), 0.35 mm (0.015 inches) thick.
- C. One-line diagrams may extend beyond the drafting field (Reference LANL Drafting Manual, 202 Section 3.0.g) for clarity purposes only.
- D. Existing conditions to be 0.25 mm (0.010 inches) line width, new conditions to be 0.70 mm (0.030 inches) line width.
- E. Avoid crossing circuit runs.
- F. Use conventional Drafting Standards if one-line diagram continues to another sheet.
- G. Line type for existing conditions: Phantom for conduit wiring and equipment; Dashed for enclosures.
- H. Line type for new conditions: Continuous for conduit, wiring and equipment; Dashed for enclosures.
- I. Organize drawing to be read from top to bottom. Text read horizontally or vertically, read from the right side of the sheet.
- J. Data input on separate layers (use AIA CAD layering convention). Refer to LANL Drafting Manual, Section 212, Basic Line Widths item D, for line weight and type.

**EXISTING & NEW**

Text

Wiring

Conduit

Enclosures

Equipment

- K. Equipment shall be associated with the room number in which it is located.
- L. Refer to [LANL Engineering Manual](#), Chapter 7, Section 300, ST7002 for a typical one-line diagram.

**2.0 ELECTRICAL EQUIPMENT PLANS**

- A. Show working clearances for all electrical distribution equipment.
- B. Normally equipment plans shall be shown on separate drawings as follows:
  - 1. Power Plan
    - Major electrical distribution equipment, motors, and major electrical loads
  - 2. Receptacle Plan
    - Receptacles and circuiting
    - Locations of the branch circuit panels
  - 3. Lighting Plan
    - Lighting fixtures, switches, and circuiting
    - Emergency and exit lighting fixtures and circuiting
    - Location of the branch circuit panels
  - 4. Special Systems Plan
    - Telecommunications outlets
    - Telecommunications rooms
    - Fire Alarm System
    - Security equipment
- C. Use standard symbols and blocks in accordance with [Appendix F](#) of this manual.

**3.0 WIRING DIAGRAMS**

Refer to [LANL Engineering Manual](#), Chapter 7, Section 300, ST7008 for a typical wiring diagram.

- A. Wiring diagrams shall show the connection of an installation or its component devices, controllers', and equipment.
- B. A wiring diagram may cover internal or external connections, or both, and shall contain such detail as is needed to make or trace connections that are involved. It usually shows the general physical arrangement of devices and device elements and also accessory items such as terminal blocks, fuses, power supplies, etc.

**4.0 ELECTRICAL SCHEMATICS**

A. Requirements: Use standard symbols and blocks in accordance Appendix F of this manual.

B. *Guidance:*

1. *Refer to LANL Engineering Manual, Chapter 7, Section 300, ST7008 for a typical motor schematic.*
2. *Schematic diagrams show, by means of graphic symbols, the electrical connections and functions of a specific circuit arrangement. The schematic diagram facilitates tracing the circuit and its functions without regard to the actual physical size, shape, or location of the component device or parts.*
3. *Schematics are intended to show major components and the flow of electrical power and control.*
4. *Schematics are not intended to show wire sizes or terminations, etc. Refer to LANL Engineering Manual, Chapter 7, Section 300, ST7002 wiring diagram for detail to be shown on a wiring diagram.*

**5.0 ELECTRICAL SCHEDULES**

Refer to [LANL Engineering Manual](#), Chapter 7, Section 200, Figure 247-1 for typical electrical schedules.

A. Use standard symbols and blocks in accordance with Appendix F of this manual.